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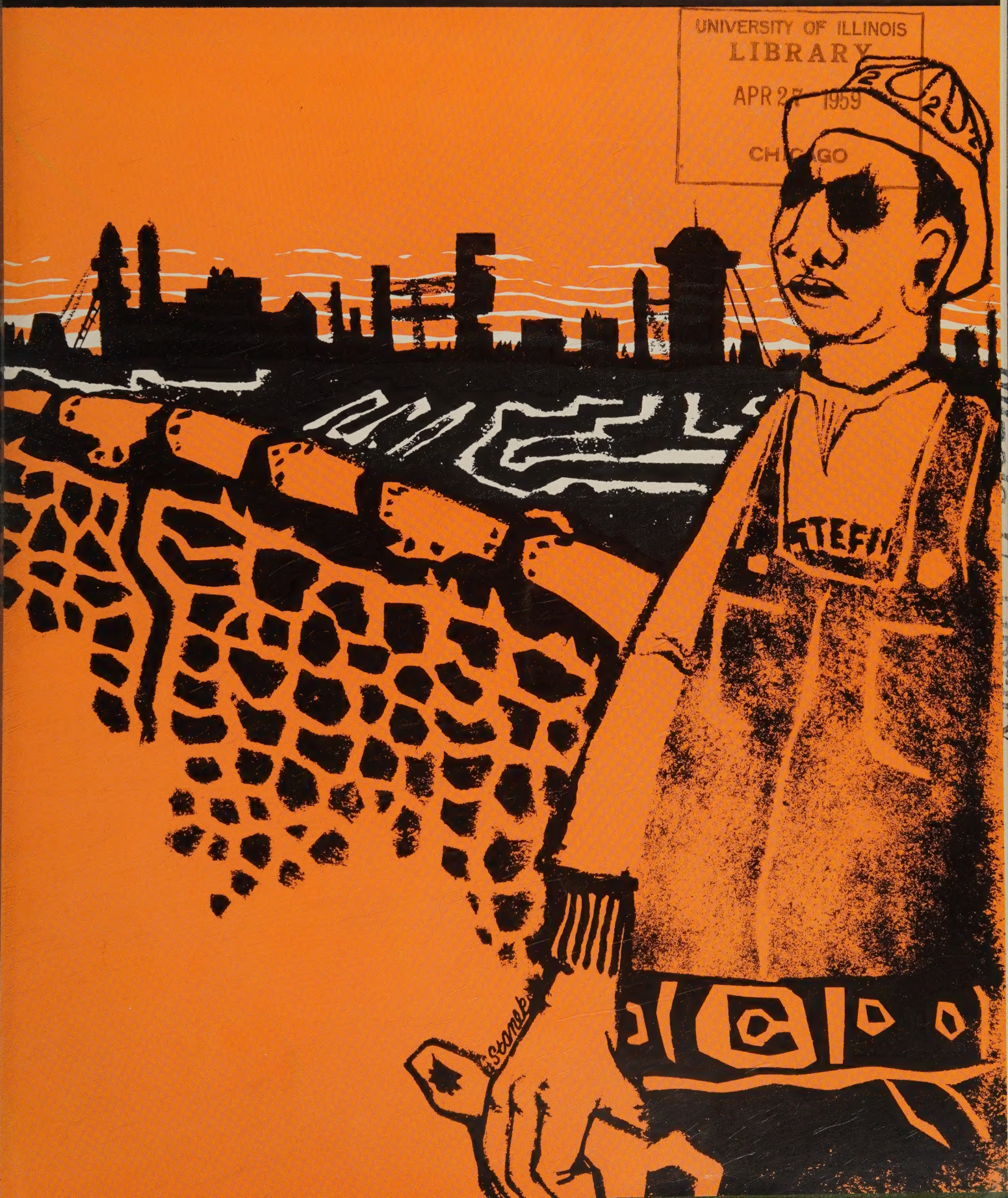

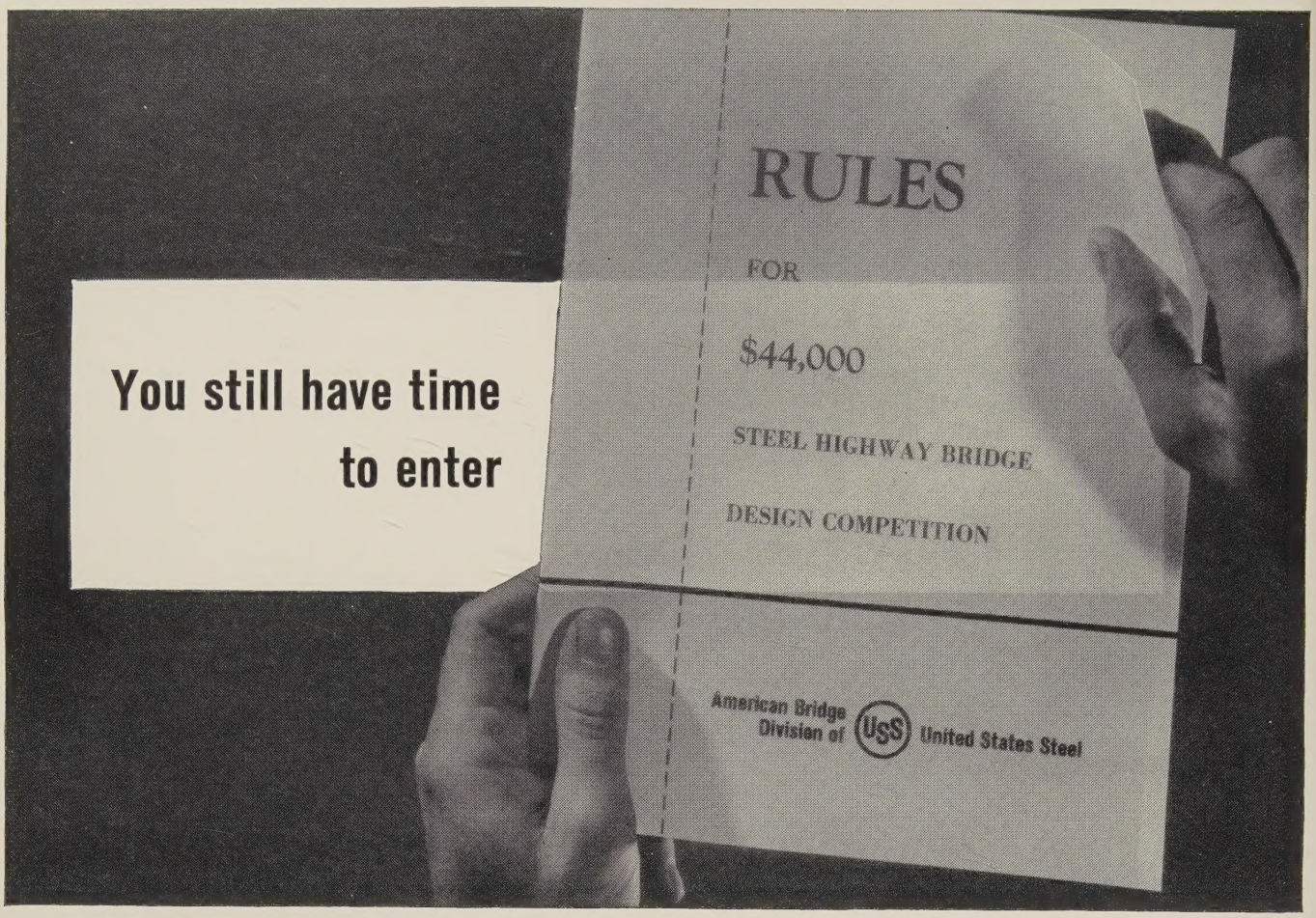

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THE ILLINOIS TECHNOGRAPH

Volume 74, Number 5 February, 1959

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Cover . . .

The artist, Bob Stanek, has gone into the realm of the semi-abstract for this month's cover. It sets a mood, but that must be left up to the reader.

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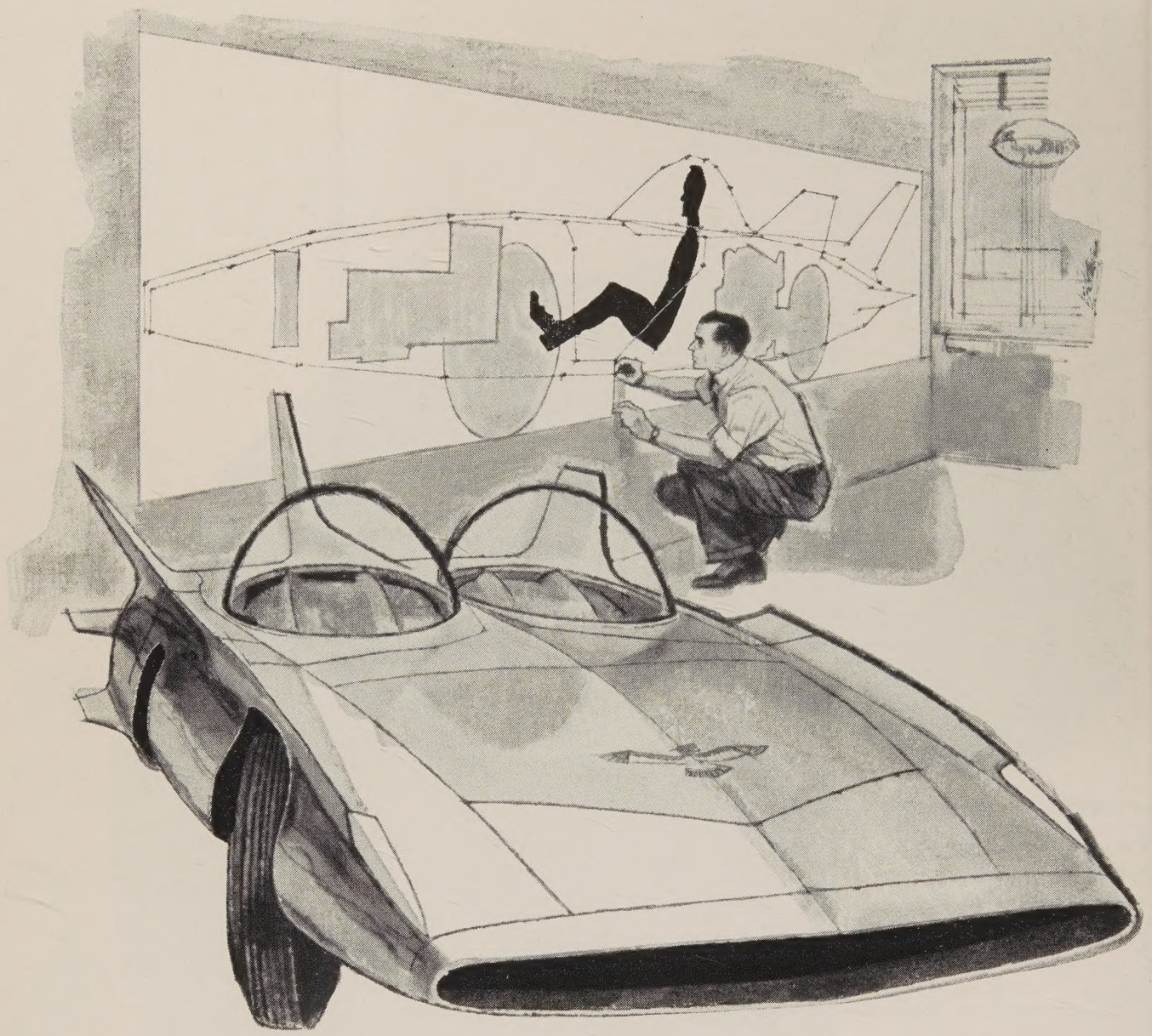

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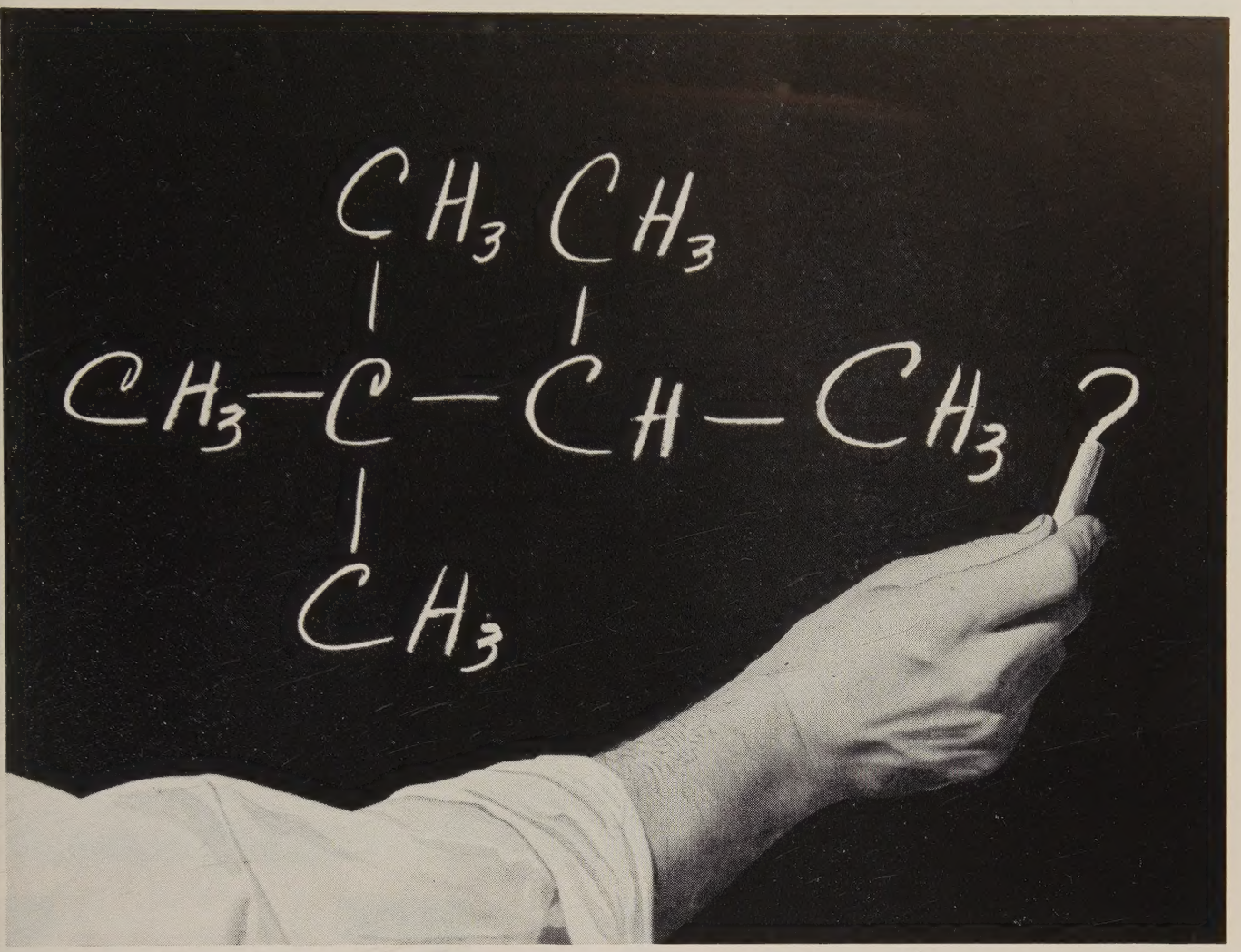

Triptane, whose formula is shown above, represents one of the most important challenges in petroleum research. Although oil companies have been working with this valuable gasoline anti-knock component for 15 years, no method for low-cost commercial production has yet been developed.

We don't have all the answers...yet!

We already know quite a bit about triptane, whose formula is shown in the picture. It is a branched heptane. Scientists at Standard Oil's laboratories can tell you that its octane number is 113. It is one of the best gasoline ingredients ever discovered.

As far back as 15 years ago, triptane could be produced in tank truck quantities. But no one has yet developed a large volume commercial method of making this valuable material.

Triptane represents but one of the creative research challenges that exist in the oil industry. A commercial way to make cyclopentane, another anti-knock material, ranks high on the list of unsolved problems. The same is true of certain hydrogenated polymethyl naphthalenes; their high energy content and low pour-point make them ideal for jet fuel.

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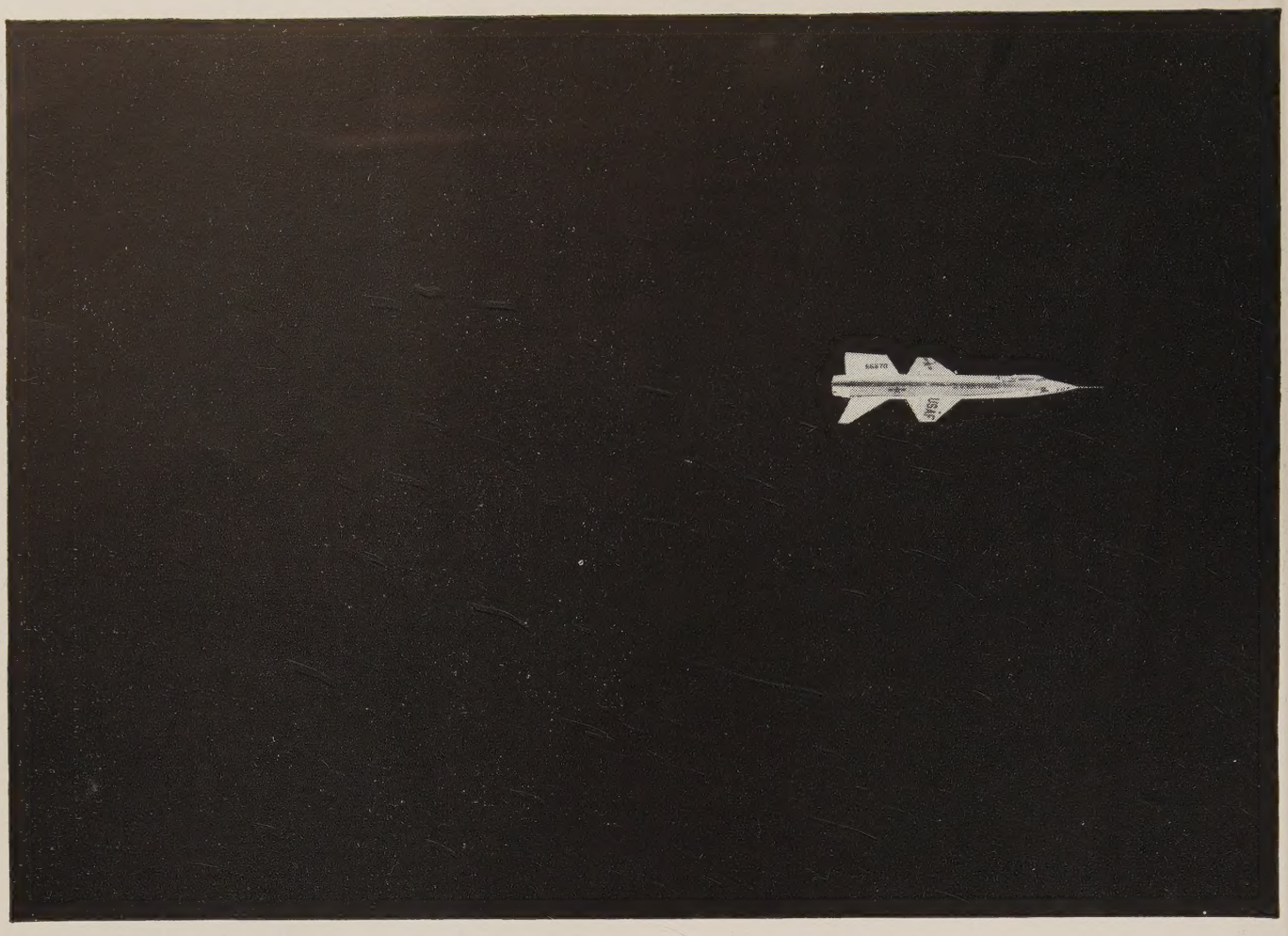

PPG glass will be there at...

mach 5+!

Sometime in March, North American's needle-nosed X-15 will be air dropped from a high flying mother ship. In minutes, its powerful rocket engine can flash the slim, hypersonic X-15 up into flight areas unexplored by man. Top speed: mach 5 plus—over 3600 mph.

The windshield of this rocket-like aircraft is double-glazed installations of glass by Pittsburgh Plate. The outer glass is tempered Herculite® heat-resisting glass; the inner is laminated safety glass with a Silicone interlayer. These specially fabricated X-15 windshields were made to resist terrific temperatures and to meet all other loads to which they will be subjected in this high performance, pressurized aircraft.

Developing glass for hypersonic flight is just one challenge being met every day by scientists and engineers of PPG's research and development program. New knowledge about glass—its structure, its form, its manufacture—are vitally influencing trends in the architectural, automotive and electronics fields. And the versatile properties of glass make it an important factor in the coming Space Age.

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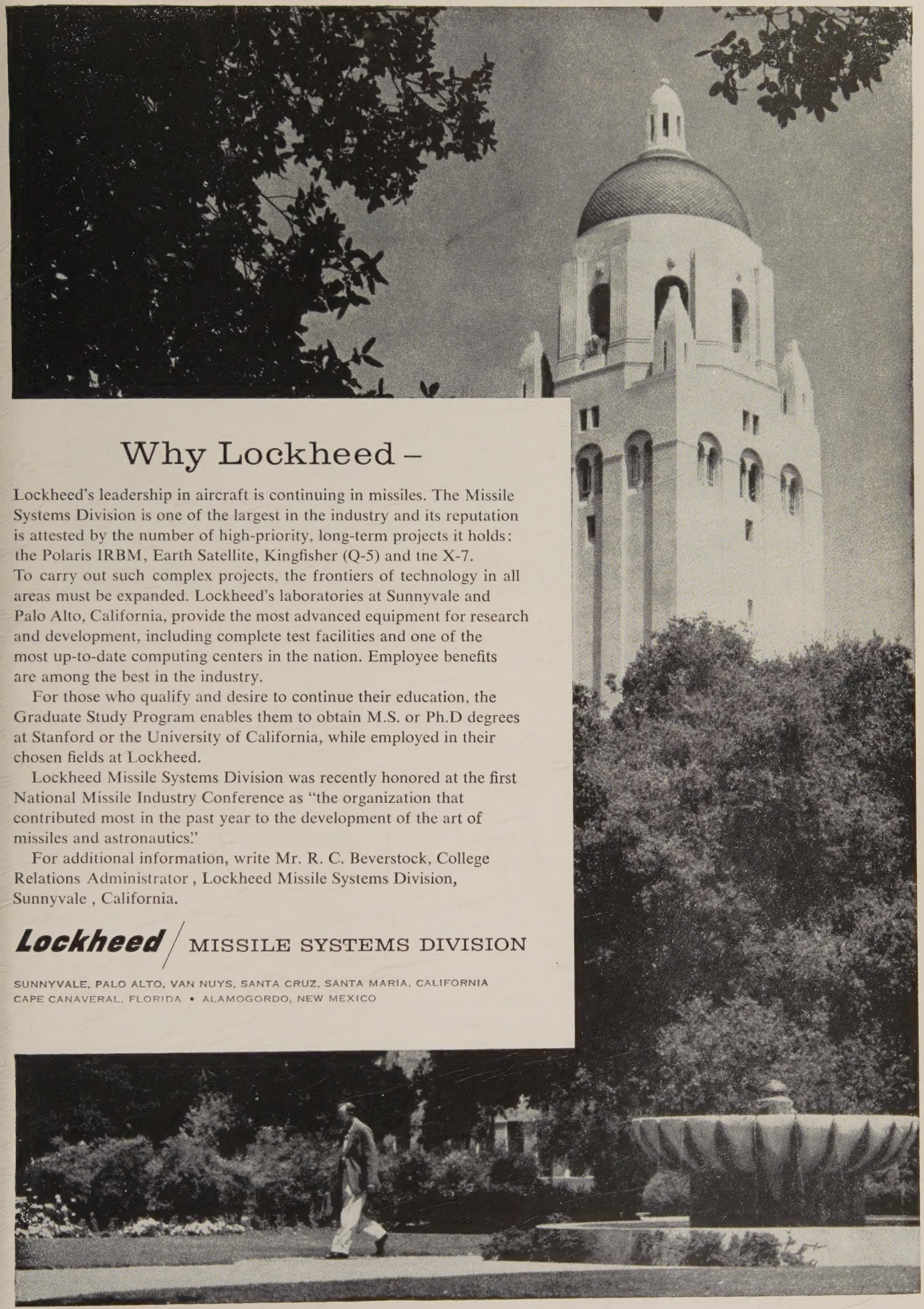

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Lockheed's leadership in aircraft is continuing in missiles. The Missile Systems Division is one of the largest in the industry and its reputation is attested by the number of high-priority, long-term projects it holds: the Polaris IRBM, Earth Satellite, Kingfisher (Q-5) and tne X-7. To carry out such complex projects, the frontiers of technology in all areas must be expanded. Lockheed's laboratories at Sunnyvale and Palo Alto, California, provide the most advanced equipment for research and development, including complete test facilities and one of the most up-to-date computing centers in the nation. Employee benefits are among the best in the industry.

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Lockheed Missile Systems Division was recently honored at the first National Missile Industry Conference as "the organization that contributed most in the past year to the development of the art of missiles and astronautics."

For additional information, write Mr. R. C. Beverstock, College Relations Administrator , Lockheed Missile Systems Division, Sunnyvale , California.

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3. What type of training program does Alcoa offer?

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4. What is the starting salary at Alcoa?

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5. If I am hired, will Alcoa pay moving expenses?

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6. How does Alcoa insure personal recognition for its people?

Alcoa's personnel policies call for regular performance appraisals, individual opportunity for advanced management training, confidential and individual salary consideration and promotion from within the company.

7. How do I apply for a position with Alcoa?

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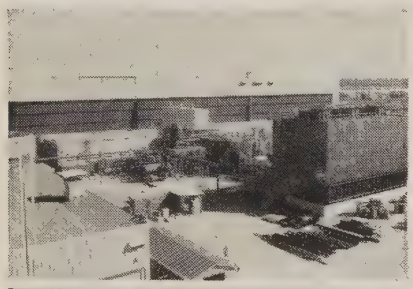

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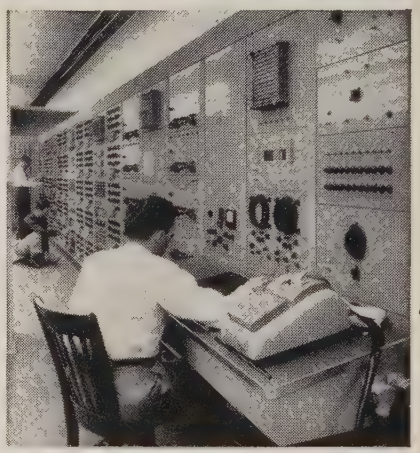

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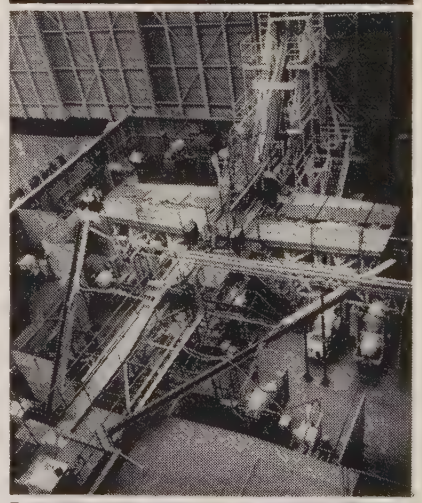
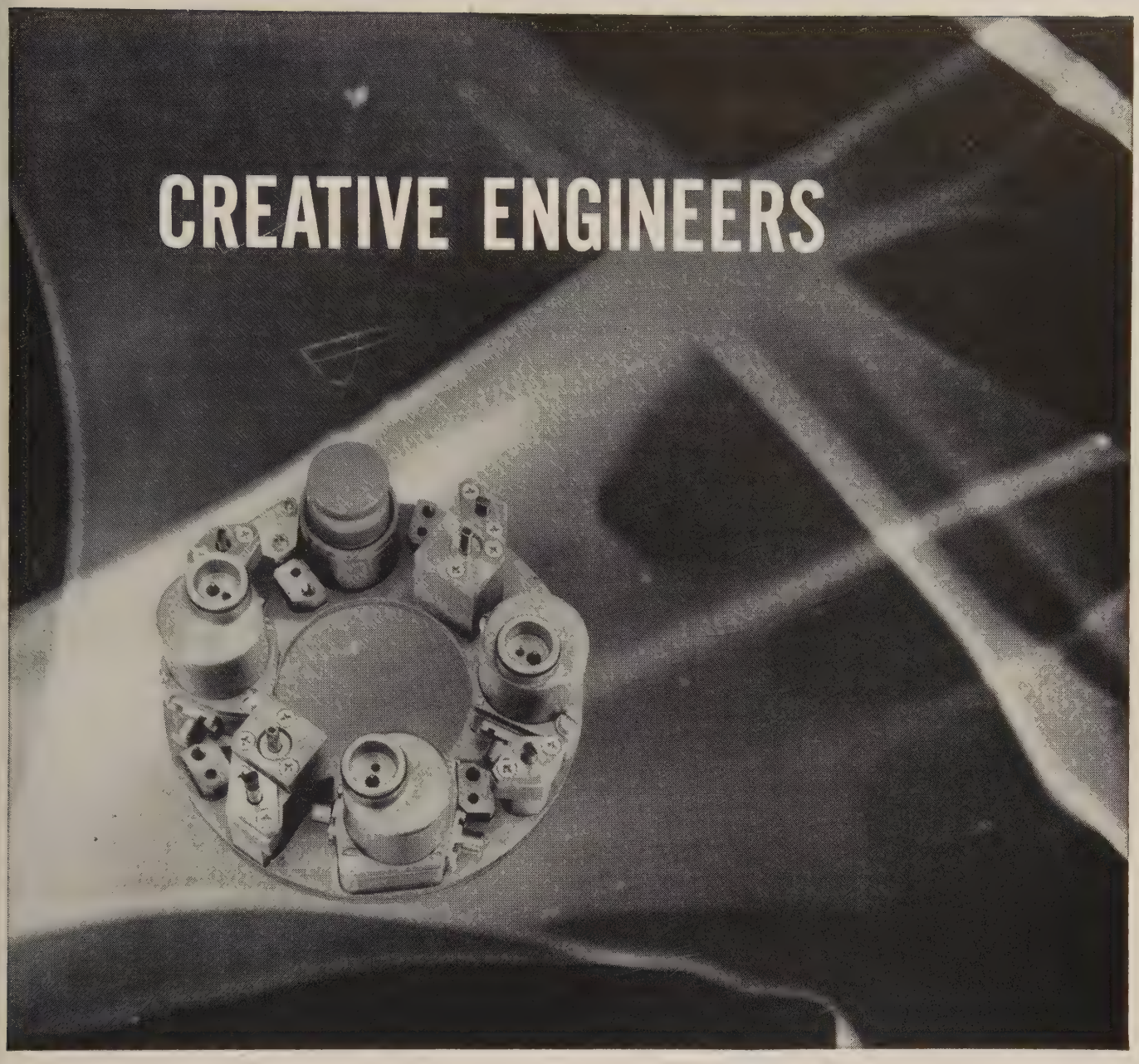


Full scale mock-up and test stand for B-58 hydraulic powered flight control system.



AiResearch engineered and produced this electro-hydraulic servo system—the most reliable and responsive steering control system for missiles yet produced. Extremely lightweight, it consists of three control valves and six actuators.

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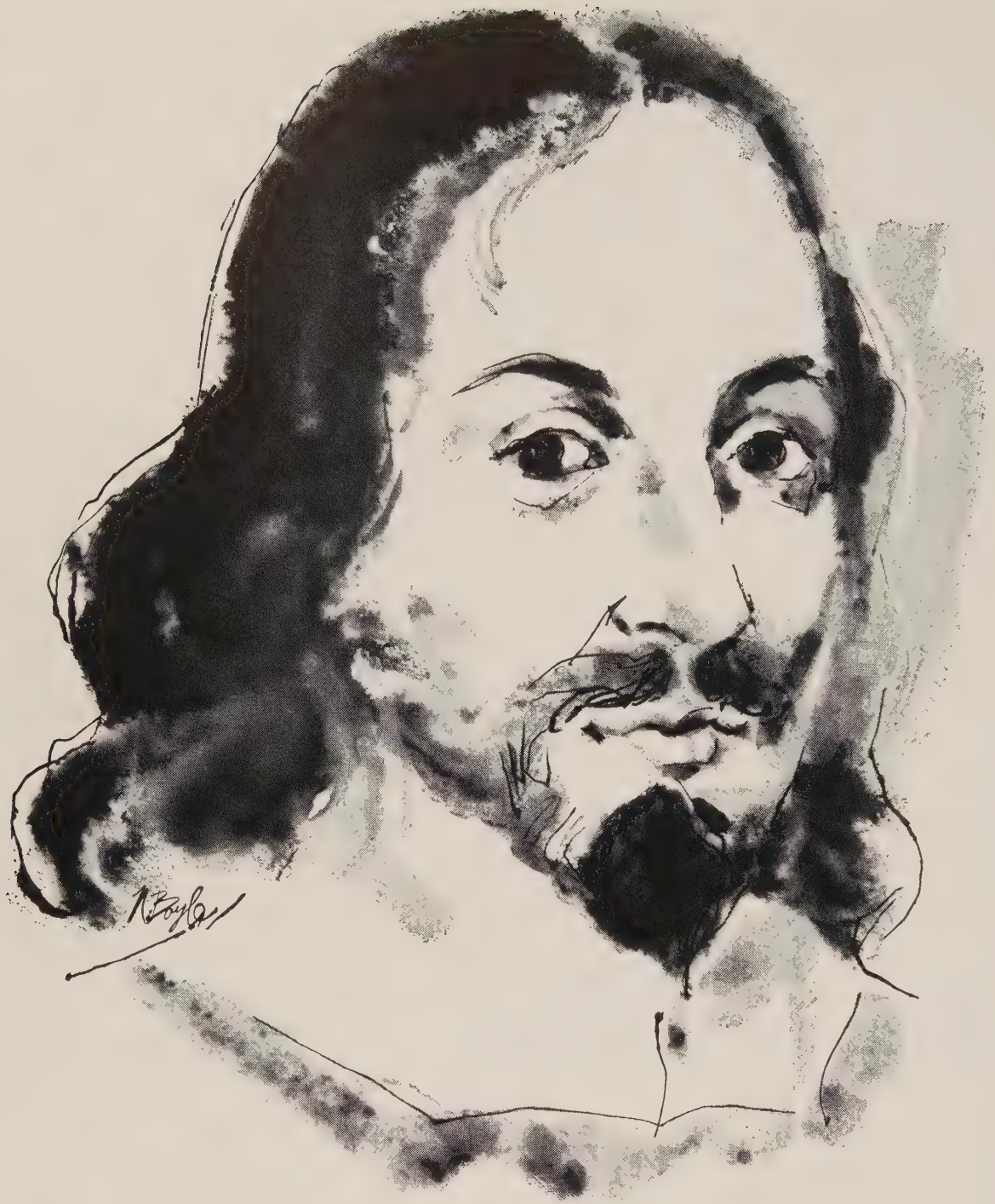


Francis Bacon...on studies

"To spend too much time in studies is sloth; to use them too much for ornament is affectation; to make judgment wholly by their rules is the humor of a scholar. They perfect nature, and are perfected by experience, for natural abilities are like natural plants, that need pruning by study; and studies themselves do give forth directions too much at large, except they be bounded in by experience. Crafty men contemn studies, simple men admire them, and wise men use them, for they teach not their own use; but that is a wisdom without them, and above them, won by observation."

—*Essays 50. Of Studies, 1625.*

THE RAND CORPORATION, SANTA MONICA, CALIFORNIA

A nonprofit organization engaged in research on problems related to national security and the public interest

(Lethargy + Apathy) Needs Action

(See Page 22)

W.D.P.

THE X-15

by Daryl Thomas

In the early summer of this year a sleek black aircraft will climb over one hundred miles into outer space carrying with it the first American and quite probably the first man ever to achieve such altitudes. The plane is the X-15, built by North American Aviation, Inc., and the man is Scott Crossfield, North American aeronautical engineer and test pilot. The X-15 is a highly designed tool which will be used for research in several aeronautical fields, the final goal of this research being to hasten the day of the conquest of space.

Prolonged weightlessness is one such field that will be studied extensively since this plane will be able to fly a parabolic arc for approximately five minutes, thus subjecting the pilot to zero *g's* for this period of time. The interesting phenomenon of zero weight can be explained rather simply. When the plane is flying a parabolic arc, the rocket motor is dead, and the only force acting on the plane and the pilot is the force of gravity which accelerates them toward the earth with an acceleration of *g*. Since both the plane and the pilot have exactly the same acceleration, there is no net force between them, and, therefore, the pilot is in a state of zero weight with respect to the plane. The effects of prolonged periods of zero *g's* are not yet completely known, as to date even the fastest jet plane can fly a parabolic arc for only a few dozen seconds. Studies so far indicate that some people loose coordination under such conditions; therefore, scientists and engineers are very eager to learn more about the effect of weightlessness upon crews of future manned satellites and interplanetary space flights.

Information on various aspects of control and stability of high speed aircraft under atmospheric, partial vacuum, and complete vacuum conditions will be collected and studied. Structural problems involving high accelerations and heating effects as well as flight techniques for re-entry can be clarified by the X-15. The information and knowledge gained from the experiments with the X-15 will be put to use in future planes, missles, and space ships.

A plane to assist in solving these problems was first conceived in 195 by the National Advisory Committe for Aeronautics. Specifications of th 33,000 pound, rocket-propelled plan were released in May 1954 by the Na tional Aeronautics and Space Agency and invitations to bid were sent to con tractors in December 1954. Nort American Aviation, Inc., the low bid der, was awarded a contract to buil and to do all necessary research in orde to build three of these planes, the tota cost of the contract being around 12 million dollars. Of this sum, the Ai Force is paying about 116 million, th remaining five million being paid b the Navy. North American engineer immediately started work on the proj ect, and by September 1957 actual con struction began. The first of the thre X-15's rolled from the assembly lin in October 1958.

In early March 1959 the X-15, slung under the wing of a B-52, was giver its first captive airborne test. Many more captive tests are planned before the plane makes its first unpowered drop test. For this test the plane wil

be dropped from the B-52 to make dead stick landings at speeds up to two hundred miles per hour at Roger's Dry Lake in California. This test is done in order to familiarize the pilot with the plane's handling characteristics in powerless flight since this will be the conditions under which it will actually land.

The X-15 is quite possibly the most tested aircraft ever constructed. More than two million engineering man-hours have been spent on it. Wind tunnel tests totaling more than four thousand hours have thoroughly examined the aerodynamic properties of the external surfaces. Every detail of design, construction, and testing was handled with meticulous care.

The rocket power plant is designed and manufactured by Reaction Motors, Inc. Designated the XLR-99, the rocket delivers a static thrust of over fifty thousand pounds of fuel per minute, a consumption rate which is twenty times greater than the fastest jet fighter with afterburner. Power can be delivered for about ninety seconds with the amount of fuel carried. The pilot can control the rocket within a 50 per cent range of its power spectrum by means of a vernier adjustment. Fuel for the rocket consists of liquid oxygen kept at –300° F and anhydrous ammonia. Positive fuel feed is assured by the use of pressurized helium to force the fuel into the firing chamber. Unfortunately the XLR-99 will not be ready for delivery during the first phases of the testing program; therefore, two XLR 11-5 engines, the type which powered the Bell X-1, have been mounted in the plane for the time being. Their combined thrust is in the neighborhood of twelve thousand pounds.

Skin temperatures upon re-entry are expected to be around 1000° F. At this high temperature level, aluminum alloys have the strength of butter, and high alloy steels become soft. The International Nickel Company has developed an alloy consisting of 76 per cent nickel, 15 per cent chrome, and small percentages of iron and maganese which forms the entire outer skin. Called Inconel-X, this alloy can retain its properties at temperatures from –300° F. to 1200° F. A major drawback to this alloy is its resistance to forming and machining. North American experimented several months before finding the correct pressures and temperatures at which to weld the metal. For the air frame itself, an alloy of stainless steel and titantium is used. This steel resists corrosion and softening at elevated temperatures.

Since the weight penalty of conventional retractable landing gear is too great, a compromise system was designed. The nose houses a standard nose wheel while two steel skids are located in the rear of the fuselage. Before landing, the pilot jettisons the bottom verticle fin so that it will not intefere with the skids, and the skids drop down into landing position. The fin, of course, has to be replaced after every flight.

For control of the X-15, Crossfield has a choice of three sticks which are placed side by side in the cockpit. The right hand stick provides control under high acceleration loads as the conventional center control stick is ineffective under such conditions. The left hand stick operates the steering rockets for control in the near-vacuum of outer space where usual control surfaces are useless. The center stick can be used for landing purposes if the pilot so desires.

The use of steering rockets is a completely new method of control. One rocket, pointing upward, is placed at each wingtip, and four more are located in the nose — tip, bottom, and sides. They are powered by the decomposition of hydrogen passing over a catalyst. The wing rockets provide roll control, and the nose rockets handle pitch and yaw by introducing an unbalanced couple and force which oppose the direction of unwanted motion. This type of system is extremely sensitive, requiring the pilot to spend long hours in an operating mock-up in order to attain the proper feel of the controls.

Perhaps the most unusual features of the plane are the wedge shaped verticle stabilizers which are twenty-three inches wide at the rear roots. This seemingly incongruous design for hypersonic flight has been proven by extensive wind tunnel tests. The wings, short and stubby, are no larger than necessary to permit control during landing. Cameras have been mounted on the body in positions to view the wing tops, horizontal and vertical stabilizers, and landing gear during the flight.

For about half of its length, extending from just behind the cockpit to the tail surfaces, the body is fairly straight. Two more or less triangular shaped blisters on the sides run from behind the cockpit to the rear of the fusalage and carry the electrical, hydraulic, and control circuits. These blisters leave the internal volume of the fuselage to carry fifteen thousand pounds of liquid oxygen and anhydrous ammonia. The fuel is enough to supply the rocket for about ninety seconds of burning at full power. Baffle plates in the oxygen and ammonia tanks prevent the liquids from flowing back and forth, an effect which upsets the craft's center of gravity.

A fifty pound guidance system similar to those used in missiles has been designed for the X-15 by the Speery Gyroscope Company. The system, which keeps a fixed reference in space, transmits, via a computer, a pictoral image of the plane in space to the instrument panel. From this the pilot gains the necessary navagational information needed in flight.

A servo-positioned, gimballed sphere

(Continued on Page 39)

Suspended from a specially built pylon, the X-15 is carried to an altitude of seven miles for aerodynamic and systems checks, and for crew familiarization.

Electronics . . .

FUTURE DESIGNS OF SECONDARY EDUCATION

by Dr. B. Everard Blanchard

Editor's Note—Dr. Blanchard is the director of Educational Associates in Villa Park, Ill. This article was written in accordance with the requirements for the technical article contest and will be judged accordingly. Any comments on this article will be appreciated.

With secondary schools over the entire nation undergoing the critical scrutiny of lay and professional individuals, many things are bound to occur in the immediate future which will either discard, modify or add to our existing knowledge concerning the purpose or goals of education.

Since the early history of education, educators have encountered time and again, the problem of how best to evaluate the progress of pupils. For example, there is a definite difference between instruction and teaching. One might instruct a student to operate a projector thus showing him all the intricate steps in properly threading a film to show to students in a classroom. After the student has been shown by demonstration, he may then repeat the movement and the instructor might tell immediately whether he has been able to follow directions or not. Mistakes this way can be easily detected. The skill is simply a mechanical factor which can be taught in a simple manner by any teacher. Teaching involves a factor decidedly different. For example, an instructor may be illustrating a mathematical formula. The ability of a student to solve a problem not only may involve elementary thinking, but thinking in the abstract and applying his knowledge. How a student goes about solving a problem, taking certain logical steps toward its completion involves certain mental potentialities which almost defy description. Why a student thinks as he does is still an unknown factor in education. How a student thinks is equally uncertain. Hence, one of the primary difficulties in testing for knowledge and its practical application in everyday problems is the fact that we are still striving for some efficient method in evaluating students' progress in schools.

The search for some precision instruments which will enable educators to measure this progress of pupils in school may not be too far away. New developments in electronics show promising correlations with education, if educators will take the time to recognize these achievements in engineering. The time may come when many public and private schools throughout the nation will be utilizing the accomplishments in electronics to aid them in solving what now appears to be unsolvable. There is no doubt in the mind of the writer, that engineering will play a conspicuous role in our educational system and the training of all future prospective teachers will be geared to these demands thus enabling education to advance in greater strides than any century of education has ever witnessed previously. The skeptical reader may doubt what the writer has just described, but let us take a moment to review some of the newer designs in electronics which may mean a revolution in future educational circles.

For many years now, physicians have been alert to the idea that life is largely an electrical phonemena. It is well-known that the brain, heart and muscles have the habit of sending out faint, but completely audible electrical messages which tell vivid stories of their functioning to the reputable physician. Electrocardiographs, encephalographs and myographs have become standard tools of the medical profession.

The Mayo Clinic researchers have put new electronic knowledge to work in the area of surgery. For example, in checking the depth of anesthesia, physicians generally depend upon external signs — pulse, blood pressure, eye dilation, etc. Apparently brain waves are more sensitive indicators and Mayo research men have profited from this fact in designing an automatic anesthesia machine. In the event that a patient may be on the point of awakening, the machine automatically administers more anesthesia and if sleep is too deep, it shuts off valves thus decreasing the amount of anesthesia.

Brain waves are additionally helpful in diagnosing a number of disorders, such as, epilepsy, various injuries, tumors, etc. The Massachusetts Institute of Technology and Boston's Massachusetts General Hospital are utilizing an approach of introducing tape-recorded brain waves into an electronic computing machine which automatically separates them into diagnostic patterns. Since knowledge of the disorders is already on hand, the patterns serve as an index for treatment of the patient. Let us now imagine a similar situation existing in a school system. Such measurements recorded on pupils might be used to determine maximal abilities in certain academic studies, thus the instructor knowing the maximum competencies of each pupil, could regulate his instruction, or teaching, and better meet the needs and interests of students. Retarded students could similarly be treated, thus failure would become an unknown factor in teaching as each student would be working to his highest level of ability. Each student could thus progress to his full capacities in gaining an education.

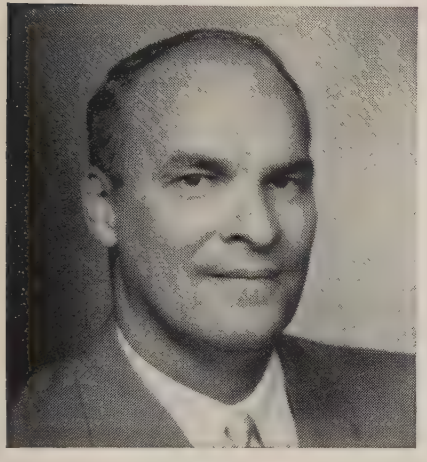
Many new electronic devices are ad- technicians. The sanguinometer developed by the Sloan-Kettering Institute and Radio Corporation of America serves us as another example. The sanguinometer may be described as a closed-circuit TV system which makes blood counts. This is accomplished as the machine reviews a blood sample and an enclosed electrical computer in a matter of seconds completes the blood count. This same machine is also finding its way into other occupations, in diaries

(Continued on Page 18)

YOUR INTERESTS, SPECIAL ABILITIES ARE IMPORTANT WHEN DU PONT MAKES YOUR FIRST JOB ASSIGNMENT

BENEFIT PROGRAM MEANS ADDED INCOME

by A. F. Hartford, Jr.
Du Pont personnel representative



Don't forget the "extras" of an employee benefit program when you compare the job offers and salaries of different companies. At Du Pont, these extras mean added income that doesn't always meet the eye. They include life insurance, group hospitalization and surgical coverage, accident and health insurance, pension plan and paid vacation.

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If you have specific questions on Du Pont benefits, just send them to me. I'll be happy to try to answer them. E. I. du Pont de Nemours & Co. (Inc.), Room 12421 Nemours Building, Wilmington 98, Delaware.

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Where do your interests lie? What courses have you taken? What are your special abilities? Du Pont tries to match these factors with available openings to determine your first assignment within the Company.

Once the assignment is made, the Company helps you apply your knowledge to a problem right away. You learn by doing and by consulting with your supervisor and others working on various phases of the same project.

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SEND FOR INFORMATION BOOKLET

Booklets about the kinds of technical jobs at Du Pont are yours for the asking. Subjects include: mechanical, civil, metallurgical, chemical, electrical, instrumentation and industrial engineering; technical sales, business administration, research and development. For a copy of one of these booklets write to Du Pont, 12421 Nemours Building, Wilmington 98, Delaware.

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Just what does a mechanical engineer *do* at Du Pont? Whether your chosen field is research, development, design, production supervision or plant engineering, you'll find many of the answers to this question in the informative film, *Mechanical Engineering at Du Pont.*

From start to finish, this film has been prepared with the young engineer in mind. Its express purpose is to show him where he fits into the picture—what kind of assignments he will be called upon to handle in the chemical industry.

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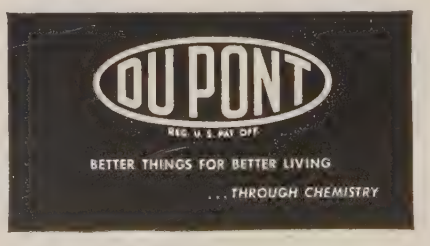
If you would like to learn in considerable detail what mechanical engineers do in the chemical industry, arrange to see this Du Pont film. *Mechanical Engineering at Du Pont* is available at no cost for A.S.M.E. chapter meetings, fraternity house and dormitory showings. Write to Room 12421 Nemours Building, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.



(Continued from Page 16)

and in checking airborne pollen. Why not use this same machine in checking tests which teachers administer to pupils? Certainly many precious man hours are lost each testing period as teachers pour over the results in endless hours which may have been diverted elsewhere assisting our youth in school situations.

Additionally, the sanguinometer also might be an indispensable aid to the teacher in pre-testing situations. For example, we know the amount of material each pupil should be able to master over a given period of time, hence in lieu of having all students pass through the portals of each class, could not some of the more superior pupils be given a pre-test with the instrument and within the matter of a few seconds, we might permit such a student to waive taking the course and progress to other areas of the curriculum without wasting time on trivia. Thus the gifted students could make the headway in gaining an education which today many are denied by virtue of the lack of such a procedure!

Another interesting application of the field of electronics is in the field of cytology. Students in this area have been hampered for years in the study of cellular structure. In order to see cells, cells must be stained and in many cases, after staining, the cells die. Scientists at the Rockefeller Institute for Medical Research and RCA engineers at the David Sarnoff Research Laboratory have developed an apparatus which makes living cells clearly visible. For example, invisible ultraviolet light of some three wavelengths illuminates the cells under a microscope. At that point, a TV tube then translates the ultraviolet into visible red, blue, green. Thus, living cells are viewed in color and for the first time it is now possible to see complicated life processes at work.

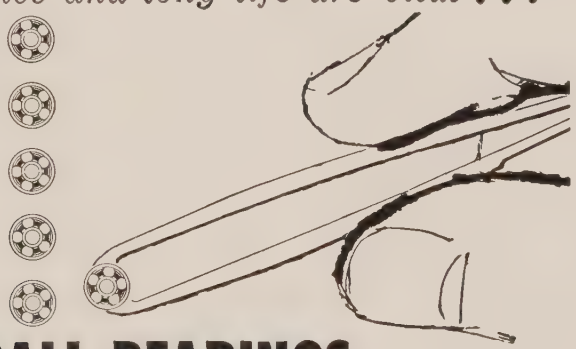
Along somewhat the same vein, educators using such a device might be able to view the brain cells involved in thinking. Perhaps, one of the reasons why some students are slow thinkers might be due to the nature of cellular action and reaction and the same might be applicable to the fast thinker in educational situations. Knowing the structure of brain tissue, we might be in a position to improve the intellect of the human race if we knew how it functions under stress and vice versa. This is only a conjecture, but the possibility is interesting.

In the area of opthalmology, a woman blind for approximately 18 years was suddenly able to "see" due to a phototube connected to the visual cortex. The woman saw the flash of light when an electric current was fed into the phototube. If this simple experiment is further validated, it may show itself to be an interesting instrument in the area of education. Schools for the blind may some day be able to teach their students to see the objects they now "imagine" in the classroom. Another probability for the use of such an instrument might lie in the area of abstract thinking, for example, mathematics. As everyone readily knows, there are some individuals who are capable of grasping the significance of a mathematics problem merely upon being exposed to its presentation. They are exceptionally fortunate students, but the great mass of our youth in school today detest mathematics due to the complicated thinking involved in attempting to solve a problem. Such resistance deters many a capable student from progressing academically. If this phototube can be further validated in other experimental work, it could be utilized in classes of mathematics by permitting each student to see the problem internally in addition to having it explained externally by the use of a blackboard as is the common practice today. Since the greatest labor in solving all life's problems takes place internally (through the use of the brain), the elimination of external extraneous factors might enable many individuals to accomplish such achievements as are now impossible due to the fact that something happens in perception from the time of the stimulus and the reaction which follows. A block of some nature may be between the stimulus and response. Thus, the phototube might afford the opportunity to eliminate this unknown barrier that accompanies thinking at the present.

Dr. Francois Paycha, a French research man, has come up with an electronic computer in which he has recorded the coded knowledge of varied diseases. His idea is to match the symptoms of a disease with the coded knowledge of the disease. This is accomplished by cards being punched with symptomatic factors and the computer then carefully diagnoses the disease. As physicians know, diagnosis is often complex and baffling, but Dr. Paycha has experienced remarkable success in his studies thus far. Dr. Andre Dubois-Poulsen, a top flight French opthmologist, using Dr. Paycha's machine fed into it the symptoms of one patient of his and the machine revealed several possible diagnoses, one of which was originally proposed by Dr. Dubois-Poulsen, the others were diagnoses of rare diseases which

(Continued on Page 21)

"Where performance and long life are vital . . ."



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Chances of pits or imperfections in the raceways are eliminated . . . superior race finishes make supersensitive bearings with low torque values. Bearings are made to ABEC-5 tolerances or better, and are equipped with separately designed retainers for correct balance.

Development of this miniature series is another example of the key role Fafnir plays in meeting the increasingly complex needs of industry. The Fafnir Bearing Company, New Britain, Connecticut.

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FORD "704"

Light Weight Gas Turbine

Development of a unique supercharged gas turbine engine of 300 horsepower was announced by Ford Motor Company.

Known simply as "The 704" the new gas turbine has been under development for two and a half years. Its weight is only one-fourth that of a truck diesel engine of comparable horsepower while its fuel economy rivals a diesel and is superior to conventional gasoline engines under most operating conditions.

"The Ford 704 represents an important break-through in gas turbine design technology," B. T. Howes, associate director of Engineering Research and Advanced Product Study, said in announcing the new engine.

The engine will be shown for the first time in a presentation to the Department of Defense in Washington.

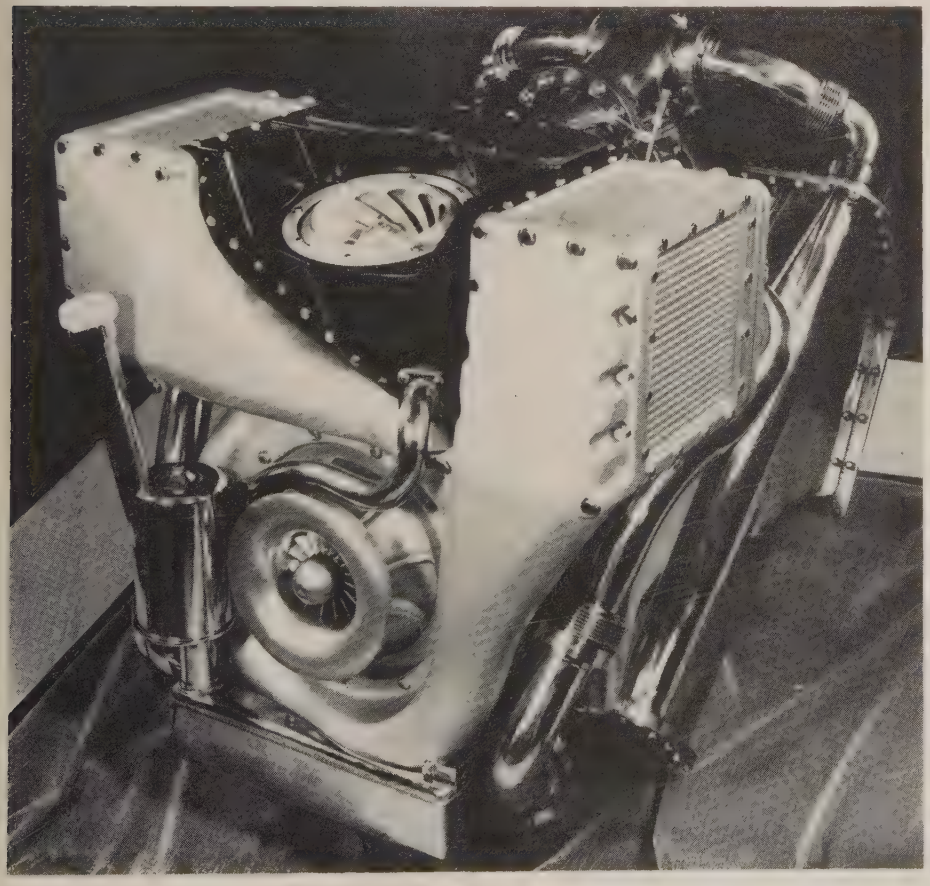
To-date, experimental gas turbines designed for trucks and passenger cars have employed one stage of air compression. The Ford 704 has two—one a supercharging stage—enabling the engine to deliver more horsepower from a smaller size. Early designs have only one combustion chamber where the 704 has dual burners.

"Our design team deliberately bypassed many conventional approaches to arrive at this concept," Mr. Howes said.

"There are many other unusual features incorporated in the Ford 704," he added. "For example, we attain maximum fuel economy in a range of 25 to 100 per cent of power. Earlier designs are efficient only when operating at full power, with fuel consumption rising sharply as power slides below the 100 per cent level."

Exhaustive component testing has been carried out during development. The next step will be testing of the engine as a complete unit.

The Ford 704 weighs 650 pounds installed, complete with all accessories built into it and requiring only the addition of electrical power and fuel. A



This is the "704," a supercharged gas turbine engine developed by Ford Motor Company.

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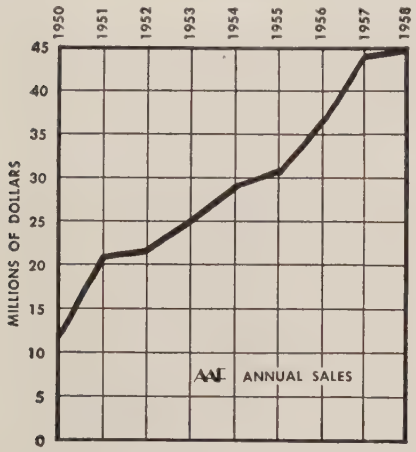


Looking for a solid, satisfying career with a vigorous company in a growing industry? American Air Filter Company, Louisville, Kentucky — world's largest manufacturer of air filters, dust control and heating, ventilating and air conditioning equipment — needs graduate engineers to fill responsible jobs in sales, engineering and production in its 173 field offices and eleven manufacturing plants located in seven cities.

Next summer AAF will inaugurate its next five-month technical training course for a select group of engineering graduates. This full-time program combines classroom work, under the direction of competent instructors, with field trips to both company plants and large industrial users of AAF products.

An American Air Filter representative will be on your campus at an early date to interview interested seniors. For the exact date and time, contact your Placement Office, now.

American Air Filter Company, Inc.

Louisville, Kentucky

AAF

diesel truck engine of comparable horsepower weighs about 2,700 pounds.

"The 'package' size of the 704 is approximately 38 inches long, 29 inches wide and 28 inches high," Howes said. "To draw a comparison, it would fit easily into the engine compartment of a 1959 Ford with room to spare."

A wide variety of fuels can be used —unleaded gasoline, kerosene, jet engine fuel (JP4) or light diesel fuel— and no warm-up period is required.

Each compressor stage effects a four-to-one air compression. The low speed compressor turns at 46.500 revolutions per minute and the high speed at 91,-500. Both the primary and re-heat combustion chambers operate at 1,700° Fahrenheit. Exhaust gases are discharged at about 740° F., or roughly the same temperature as conventional passenger car engine exhaust.

"The Ford 704 gas turbine is suitable for any application requiring about 300 horsepower and good fuel economy over a wide operating range," Howes said. "It has been designed for high reliability and long life."

Possible applications besides cars and trucks, he added, might include tanks, heavy duty tractors and bulldozers, half-tracks and off-road vehicles of any type, auxiliary or stand-by power generating sets, starter carts for jet aircraft, earth movers and even small locomotives.

Ford expects to be testing the new engines in vehicles before the end of the year.

C. L. Bouchard, manager of the turbo machine department, and Ivan M. Swatman, a member of the original Ford 704 gas turbine design team, described the engine's operation in this manner:

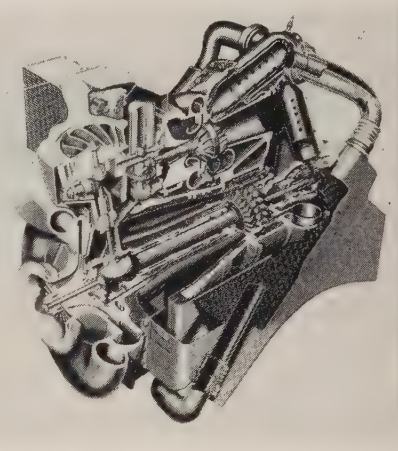
Air is drawn into the first, or low speed, compressor which operates at 46,-500 revolutions per minute (rpm). Assuming an ambient air temperature of 100° Fahrenheit, the four-to-one compression ratio raises air temperature to approximately 450°. At full engine power air flow is 2.7 pounds per second.

The air next passes through an intercooler where its temperature is reduced to about 220°. Principles of thermodynamics require use of the inter-cooler. It is an integral part of the engine, employing a centrifugal type blower driven at 19,000 rpm, through a step-down gear, from the shaft of the low speed compressor.

After cooling the air passes to the high speed compressor and through another four-to-one compression stage which raises the temperature again, this time to about 625° F. The high speed spool operates at 91,500 rpm. Another 375° temperature rise is attained as the air passes through the exhaust heat exchanger and it enters the combustion chamber at roughly 1000° F.

Fuel is added and the mixture burns in the primary combustion chamber. At 1,700° the exhaust gases drive the high speed turbine that turns the high compressor spool. Supplying power to the turbine wheel reduces the temperature to about 1,350°.

Additional fuel is added in the secondary combustion chamber to bring the temperature back up to the 1,700°. From here the exhaust gases pass through the power turbine, driving it



Cutaway view of the Ford Motor Company's new "704" supercharged automotive gas turbine showing the low pressure compressor and turbine drive assembly, lower center; intercooler fan, upper left foreground; intercooler, extreme upper left; high pressure compressor, turbine, and accessory drive, upper center; primary and secondary combustion chambers, upper right; exhaust heat exchanger, lower right; and power output turbine, right center.

at a speed of 36,000 rpm, and through two turbine wheels that drive the low speed compressor.

Next the exhaust gases move to the heat exchanger where they release heat to the incoming air after the second compression stage. They are rejected into the atmosphere at about 740°, roughly the temperature of exhaust gases from a conventional passenger car engine.

The power turbine shaft, through a step-down gear arrangement, turns the drive shaft at 4,600 rpm at full power.

The Ford 704 gas turbine engine is designed to burn .56 pounds of fuel per brake horsepower per hour at full power, .48 lbs/BHP/hr at half power, and .58 lbs/BHP/hr at one-quarter power.

Potato Chips Top Peanuts

Peanuts have been supplanted by potato chips in popularity at ball parks and other amusement arenas.

(Continued from Page 18)

he should have considered at the time, but unfortunately, he did not utilize the results.

A similar machine placed at the use of a school system might be utilized in the following manner. Suppose for example, a particular teacher taught some 100 or more students per day plus all of the other activities a teacher is obligated to perform daily. Let us presume further that this typical teacher is faced with numerous problems each day as each teacher actually faces in the task of teaching. No teacher could attempt, let alone oartially solve, all the problems she faces each day in the classroom. With the machine Dr. Paycha has in mind, such problems could be fed into it and possible solutions would be given back which would be time saved, problems solved and pupils aided.

For many years now, the educationists have attempted to solve their problems in their ivy-cloistered tower. It is high time that schoolmen throughout the country resort to correlating their work with sound scientific procedures. Research should prove invaluable and what is known today should be given the opportunity to be further explored and applied. The field of electronics suggests promising trends for education. If educators, for the moment, will take but a little time to forget their books and team up with engineers thus correlating some of the present findings with the task of educating our youth, we will find ourselves progressing faster toward accomplishing what we purport to be doing, than what we have ever achieved in the past.

Pocket Pagers Grow

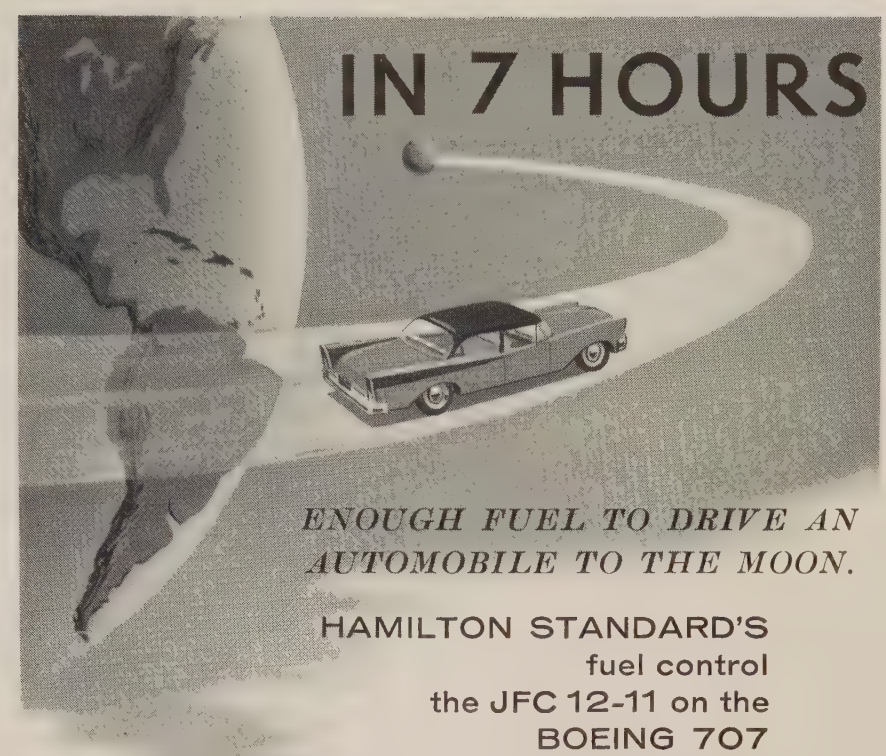
To date, more than 100 pocket radiopaging firms have sprung up throughout the country. Typical of these outfits is one which passes along some 30,000 messages a month to 1,000 subscribers. The agency serves doctors, businessmen and field service people within a 40-mile radius. Each subscriber carries a six-ounce pocket receiver.

Fishermen's Lure

A new discovery may make the hours slip by more pleasantly for "fishermen" who don't like to fish. "High-octane beverages" can now be packaged in a plastic film to save carrying weight.

Color TV Climbing

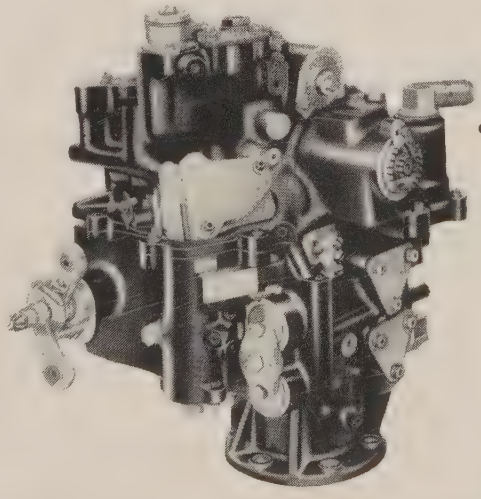
The latest tally on the number of color TV receivers in use is over 350,000, reports Electronics. This figure exceeds last year's by more than 142,000. In 1956, there were only 115,000 color sets in use.



ENOUGH FUEL TO DRIVE AN AUTOMOBILE TO THE MOON.

HAMILTON STANDARD'S fuel control the JFC 12-11 on the BOEING 707 meters about 16,000 gallons of fuel in 7 hours. At 15 miles per gallon, an automobile would consume that much in 240,000 miles.

This amazing performance is accomplished by the JFC 12-11. This lightweight, rugged, and highly sensitive unit contains a computing system and a metering system to control engine thrust. Such precision engineered components as *pressure sensing bellows, multiplying linkages, servo pistons, filtering systems, relief valves and "three D" cams* must function simultaneously to meter required fuel flow for top performance. The basic control features have been proven by over a million hours of actual flight time.



If you are interested in designing and developing such products as this, contact Timothy K. Bye Engineering Personnel Coordinator, or arrange for an interview with your college placement officer.

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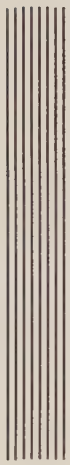

Positions are available on the editorial and production staff of The Illinois Technograph. Experience of this type is invaluable for personal satisfaction, job references, and development of creative skills. Applicants need not be engineering students. Interested persons may call the editor, Dave Penniman, at 2-4254 or leave their name at The Technograph office in 215 Civil Engineering Hall.

THE KNOLLS ATOMIC POWER LABORATORY ANNOUNCES
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** Candidates are selected each Spring for classes starting in September.*

She: "Don't you dare kiss me again. Why I hardly know you."

He: "I won't. I'm trying to find out who has the gin at this party."

* * *

Scene in an English pub:

Limey: "Alo, Mary, are you 'aving one?"

Mary: "No, it's just the cut of me coat."

* * *

"I know a man who has been married for thirty years and he spends every evening at home."

"That's what I call love."

"The doctor calls it paralysis."

* * *

Mrs. Jones was sitting in the breakfast nook shelling peas when she heard a knock at the door. Thinking it was her young son, she called, "Here I am, darling."

Silence. Then a deep voice boomed, "This is not the regular iceman, ma'am."

* * *

Pilot to navigator: "Where are we?"

Navigator to pilot: "Due to my extensive training in calculus and trigonometry, I have calculated our position to be three miles from infinity."

* * *

The wild crowd has a new game going. Three guys rent a hotel room and each brings a quart of Old Screech with him. They sit and drink for an hour, then one of them gets up and leaves. The other two have to guess which one left.

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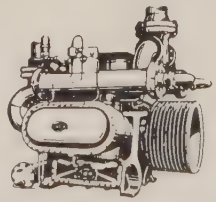
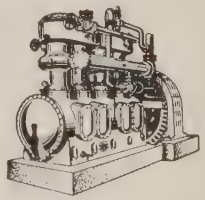


ECLIPSE COMPRESSORS



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Technocutie . . .

Photos by George Knoblock

DOROTHY McLENDON

Technograph's choice for this month is Dorothy McLendon, and we think it was a very good choice.

Dorothy, a freshman from Chicago, is in FAA and is majoring in voice training. Her home on campus is LAR.

Her interests include singing, of course, as well as swimming and tennis.

She likes to dance, including rock and roll sometimes. Also she is interested in interpretive dancing.

When it comes to boys, a good personality and like interests are what she likes in a date.

She is 5'5" tall, weighs 115 pounds, and as you can see on the right, she is just as attractive with her hair down.

EARNED DEGRESS — 1956-57 AND 1957-58

	BACHELOR		MASTER		DOCTOR	
	1956-57	1957-58	1956-57	1957-58	1956-57	1957-58
All fields	340,347	365,748	61,955	65,614	8,756	8,942
Agriculture	7,943	8,312	1,549	1,480	353	353
Biology	13,868	14,408	1,801	1,852	1,103	1,125
Mathematics	5,546	6,924	965	1,234	249	247
Physical sciences	12,934	14,352	2,704	3,034	1,674	1,655
Psychology	6,191	6,930	1,095	836	550	572
(Subtotals)	46,482	50,926	8,114	8,436	3,929	3,952
Engineering	31,211	35,332	5,233	5,788	596	647
Totals	77,693	86,258	13,347	14,224	4,525	4,599

In a list in which everything is up, science registered a gain of 9.5% in bachelor's degrees; engineering, 13.1%. In all fields the gain was 7.5% compared with 1956-57. There was a gain of 322 in the number of master's degrees granted in science, but no significant change in doctorates. It may also be noted that biology barely retained its lead over the physical sciences in degrees granted at the bachelor's level.

START TODAY TO PLAN TOMORROW

By knowing about some of the projects underway at the Babcock & Wilcox Company, an engineer may see his personal avenues of growth and advancement. For today B&W stands poised at a new era of expansion and development.

Here's an indication of what's going on at B&W, with the consequent opportunities that are opening up for engineers. The Boiler Division is building the world's largest steam generator. The Tubular Products Division recently introduced extruded seamless titanium tubing, one result of its metallurgical research. The Refractories Division developed the first refractory concrete that will withstand temperatures up to 3200 F. The Atomic Energy Division is under contract by the AEC to design and build the propulsion unit of the world's first nuclear-powered cargo vessel.

These are but a few of the projects — not in the planning stage, but in the actual design and manufacturing phases — upon which B&W engineers are now engaged. The continuing, integrated growth of the company offers engineers an assured future of leadership.

How is the company doing right now? Let's look at one line from the Annual Stockholders' Report.

CONSOLIDATED STATEMENT OF INCOME
(Statistics Section)
(in thousands of dollars)

1954	1955	1956—UNFILLED ORDERS (backlog)
$129,464	$213,456	$427,288

B&W engineers discuss developments in the Universal Pressure Boiler.

Ask your placement officer for a copy of "Opportunities with Babcock & Wilcox" when you arrange your interview with B&W representatives on your campus. Or write, The Babcock & Wilcox Company, Student Training Department, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

N-220

FLORIDA RESEARCH AND

ISOLATION—Ten square miles comprise the site of Pratt & Whitney Aircraft's new Florida Research and Development Center. Experimental shops and offices covering some 17 acres are in the foreground, while the tests areas, barely visible in upper left, lie four miles in the background.

LOCATION—The new Center is located at United Florida, midway between West Palm Beach and Lak Okeechobee, in the upper Everglades area. It is almos surrounded by a wildlife sanctuary. Most employees liv in the cities and towns along the east coast of Florida driving to the Center on excellent new highways.

DEVELOPMENT CENTER...

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uture aircraft and missiles may require propulsion ystems far different from those in wide use today - different in size, power output, appearance, and erhaps even in the basic method of utilizing energy.

To probe the propulsion future . . . and to build nd test greatly advanced propulsion systems for oming generations of flight vehicles, Pratt & Whitney Aircraft is now operating its new Florida esearch and Development Center. This facility upplements Pratt & Whitney's main research and evelopment installations in Connecticut.

The new Florida Center, financed and built by ratt & Whitney Aircraft, is unique in America's r industry. Here a completely air-conditioned ant with 17 acres under roof is specially designed nd equipped for the development of new power plants of virtually any type. Testing is handled in special isolated areas; the nearest is four miles from the plant and many miles from any inhabited area. The new Center can be greatly expanded on its 10-square-mile site. Continued isolation is insured by a vast wildlife sanctuary in which the Center is located.

Of the many people employed at the Center today, about half are scientists, engineers and highly trained technicians. By late next year, the total number is expected to be almost doubled.

The new Florida Research and Development Center is one more reason why Pratt & Whitney Aircraft is able to continue producing the world's best aircraft propulsion systems . . . in whatever form they take.

For further information regarding an engineering career at Pratt & Whitney Aircraft, contact your college placement officer.

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Division of United Aircraft Corporation

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FLORIDA RESEARCH AND DEVELOPMENT CENTER — United, Florida

THE ELECTRONIC FLASH UNIT

by George Gerstman

The electronic flash unit, also known as the "speedlight" or "strobe," made its debut to the public after the close of the second World War. In the last decade the speedlight industry has advanced rapidly, and at present, these units are used widely by both professional and amateur photographers.

The fundamentals of the electronic flash unit are simple and should be clearly understood by its user.

If a photograph is made with a camera in daylight or in photoflood light, the opening and the closing of the shutter allows a brief period of this steady light to impinge on the film. How much of this light is used depends upon the photographer's selection. It may be one second, 1/10 second or 1/100 second. In any case, a solid stream of the light flows for that length of time through the lens to make the exposure.

The procedure is quite different with the speedlight. For one thing, there is no shutter from which to select a speed because the electrical control of the illumination replaces the shutter. The shutter of the camera merely acts as a gate which is opened a convenient time before and closed at leisure after the flash of the electronic unit has streaked through the lens. The flash of the light is substituted for the opening and closing of a shutter. These units emit a flash of light that ranges in time from two milliseconds to as low as one microsecond. This does not mean that an ordinary camera cannot be used to take high-speed pictures; it means that the exposure is provided by a light flashing on and off quicker than any shutter can open or close. Though the eye seeing this flash is unaware of unusual brightness, the instantaneous intensity of each flash exceeds the light of approximately 40,000 50 watt bulbs such as are used in household lighting. Any standard camera may be used to get effective exposures as short as one microsecond.

The light from an electronic flash unit is actually a discharge spark, similar in principle to the discharge spark of a Leyden jar, or of lightning for that matter. A capacitor stores current for the speedlight. The energy it stores is a major factor in determining light output and flash duration. The measure of electrical energy stored in the capacitor or condenser is the microfarad. The voltage plays an important part in the energy calculations; microfarads alone are meaningless, and voltage by itself means little. The measurement of energy is the watt-second. The energy (watt-seconds) fed into the flashtube is the product of condenser capacity (microfarads) times the square of the voltage in kilovolts, divided by two. As an example, 60 microfarads charged to 2,000 volts gives 100 watt-seconds; and 32 microfarads charged to 2,500 volts also gives 100 watt-seconds.

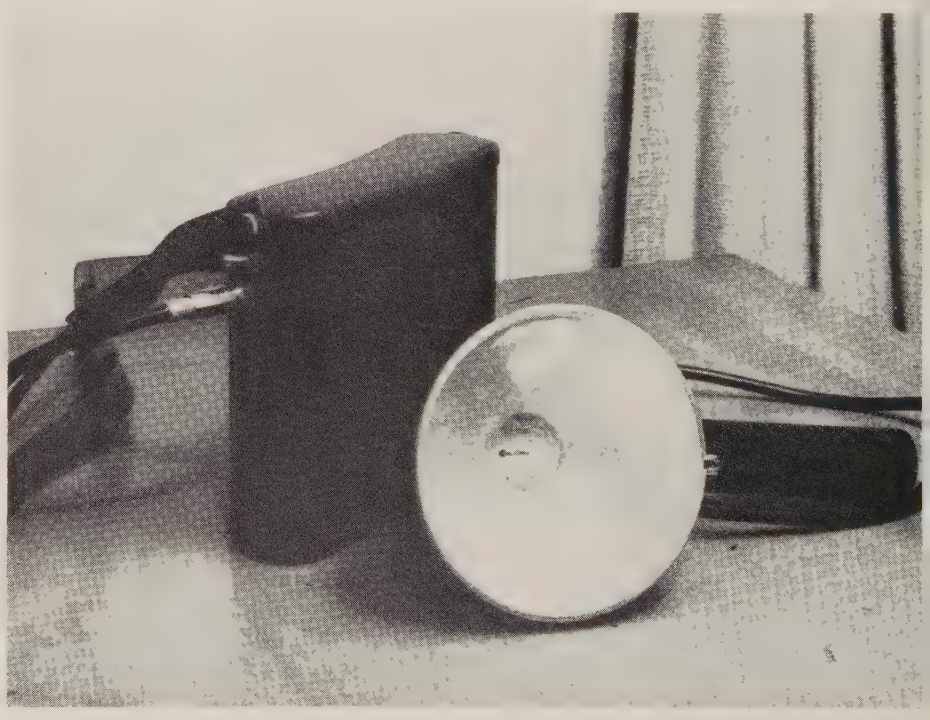
It may be noted that higher voltages are tempting because the light output rises in proportion to the square of the voltage, 4,000 volts giving four times the light of 2,000 volts, everything else being the same. The average electronic flash unit operates within a range of 450 to 2,000 volts. The chief deterrent from going to higher than 2,000 volts is increased electrical difficulties besides the greater potential danger element for the operator.

The secret of the enormous light power of a speedlight lies in the fact that a small amount of current trickles into the condenser for a relatively long time, and all of this charge is suddenly dumped in an almost unbelievably short time. Imagine a thin stream of water flowing into a pail. Many minutes will pass before the pail is full. All of a sudden the pail of water is inverted. This will give quite a deluge for just a moment. If twenty watts are charged into a condenser for five seconds, the condenser has stored 100 watt-seconds. If the condenser is discharged in 1/500 second, 5000 times 100 watts or 500 kilowatts have become available. This is a very sizeable amount of power to feed into a flash.

Condensers for speedlight service are fairly heavy and expensive. For the sake of cost, size, and reasonable portability it is recommended to restrict a speedlight to a condenser of 50 microfarads capacity.

The larger the capacity of condenser built into an electronic flash unit, the more light attainable, and the longer the flash will last. The amount of light is about proportional to its duration: much capacity, much light, relatively long flash; little capacity, little light, very short flash. The light for speedlights having a very short duration, say a few microseconds, is fed from a condenser of one, or even a fraction of one microfarad, and this light illuminates a very restricted area. A capacitor with

(Continued on Page 32)



A typical dry battery operated electronic flash unit

W.E. DEFENSE PROJECTS ENGINEERS are often faced with challenging assignments such as systems testing for the SAGE continental air defense network.

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(Continued from Page 30)

fifty microfarads capacity, with very short wire connections to the flashtube, should give a flash of between 1/4000 and 1/10,000 second.

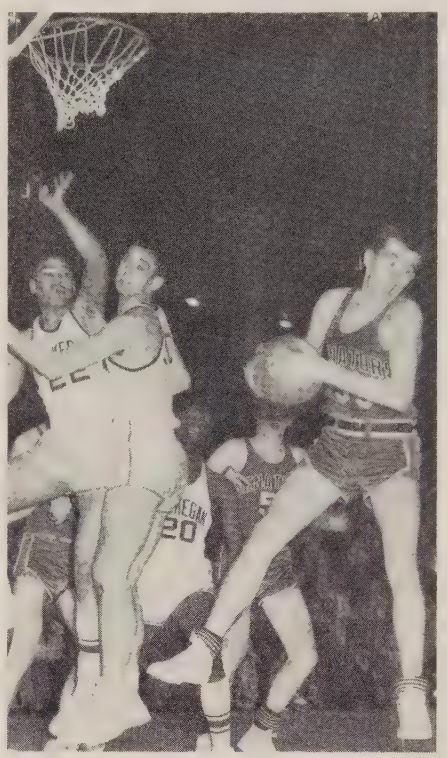
As stated previously, the flash is actually a discharge spark. The light source is usually a coiled tube with metallic-end electrodes, filled with a certain gas under a certain pressure. Since gases are normally considered to be good insulators, one might expect that no current would flow if two cold electrodes were inserted in a vessel containing gas, and a potential (voltage) was applied between them. Actually there is always a certain amount of ions and free electrons present in the gas due to the action of cosmic rays, ultraviolet radiation, or other sources of excitement. These electrons and ions flow toward the electrode of opposite polarity when a potential is applied, and produce a current flow through the external circuit. Usually this current is infinitesimal and may be neglected for most purposes; thus gases are usually treated as insulators. If the voltage is sufficiently increased, the gas will break down and cause a spark to jump between electrodes. The high voltage "kick" to ionize the flashtube is derived from a small high-ratio ignition transformer or spark coil.

In the modern flashtube the gas may be krypton, argon, or xenon; and in some cases other gases (for instance, nitrogen) are added when certain characteristics are required. The gas most frequently used is xenon. The spectral energy distribution from the source is very similar to sunlight, corresponding to a black body at 6500 K to 7000 K. The color rendering properties of the flash are therefore good. The source is particularly suitable for use with daylight color films. Xenon is a rare gas, having only one part per 20 million parts of air. It is obtained through the fractional distillation of liquid air. The tube that holds the gas is usually coiled into a spiral, or it is curved into a "U" shape. Small and medium sized flashtubes are made of glass. Quartz is used for large tubes designed for loadings of one thousand or more volts.

There are two types of flashtubes—the high pressure type and the low pressure type. The high pressure flashtube is more efficient because it gives more light per watt, lends itself to sturdier construction, is quieter during flashing, gives better color rendition, and gives more instantaneous response to triggering. However, the low pressure tube is less expensive, requires a relatively simple circuit with less wiring and fewer parts, and has a high voltage outside the power pack only during the instant of firing.

Any flashtube may be used for 10,000 or more flashes. When approaching deterioration, the light output of the flashtube decreases.

The flashes emitted by an electronic flash unit are detonated by an ordinary short-circuit. This is called "triggering." The triggering recommended by experts is of the zero delay type. Exactly how this is accomplished depends upon the type of circuit to be triggered. If a low voltage flashtube is used, it is practical to trigger it with a simple



The strobe provides an excellent source of light for photographing sporting events.

switch, or with the contacts in a flash-synchronized camera. When the contacts in a flash-synchronized shutter are closed, the ionization and flash occur within a few microseconds. If the flashtube is of the high voltage type, the problem becomes more ecomplicated. The trigger coil in this instance operates on enough energy to be unsafe and damaging to the contacts in synchronized shutters. What is needed is something that will conduct energy to the coil, yet can be controlled at the switching point by a much lower current. This is accomplished with a "strobotron tube," also called a thyratron or trigger tube. Thyratrons function as switches or relays. They consistently open and close electrical circuits with, for all practical purposes, a time delay of zero. These are sometimes used in low voltage units when precise triggering is necessary. The great advantage of zero delay lies in its dependability. Synchronization is precise every time.

There are a few ways in which voltage may be received to get a satisf tory flash from the tube. Regular 1 volt house current may be used or ev just a few volts from wet or dry ce Another source that can be used is high voltage dry battery. If all fla work is done where alternating curre is readily available, an AC unit preferable. To handle this, an electron flash unit will need a small 110 to a proximately 1650 volt ratio closed ir core transformer of 15 to 100 watt termittent output. Not many peop realize it, but it is possible to opera an AC unit from an automobile ba tery.

If full mobility is necessary, a po able battery is preferable. Battery un range in weight from two to fifte pounds. There are so called "conve able" units which permit use of bo alternating current and batteries, t choice made by the user.

The wet cells used in speedlight un are miniature versions of the famili automobile storage battery. They a two volt cells enclosed in transpare plastic cases about the size of tw packs of king-size cigarettes. To obta from this low voltage direct curre the necessary high voltage, a spark co with a vibrator is used, taking the pla of a transformer. This vibrator is the type used in an electric bell. Th wet cells give good service for a co ple of hundred flashes per charge. full charge uses about one cent's wor of electricity. These cells can be r charged a few hundred times. Wet cell however, require comparatively com plex circuits. This means extra bul and initial cost—and more componen subject to failure.

The first appeal of dry batteries simplicity of upkeep. They are simpl placed into a power pack and left alon during their entire useful life. Th shelf life of high voltage dry cells un der normal conditions is about one yea During that time one thousand to thre thousand flashes may be exacted. Th combination of a high voltage dry cel a low voltage flashtube, and an electro lytic capacitor between, gives much us able light with the simplest circui known today.

There are other items which mus go into the making of any safe efficient electronic flash unit. Such items are re sistors, auxilary condensers, pilot lights meters, switches, pushbuttons, sockets cables, etc., as are called for by th particular circuit. These various part are usually assembled into a compac chassis, comparable to a radio chassis and then placed in a wooden or meta box. The power supply (if it is an AC unit) is plugged in on one side and a special multi-conductor high-voltage ca ble connects on the other side to th

(Continued on Page 36)

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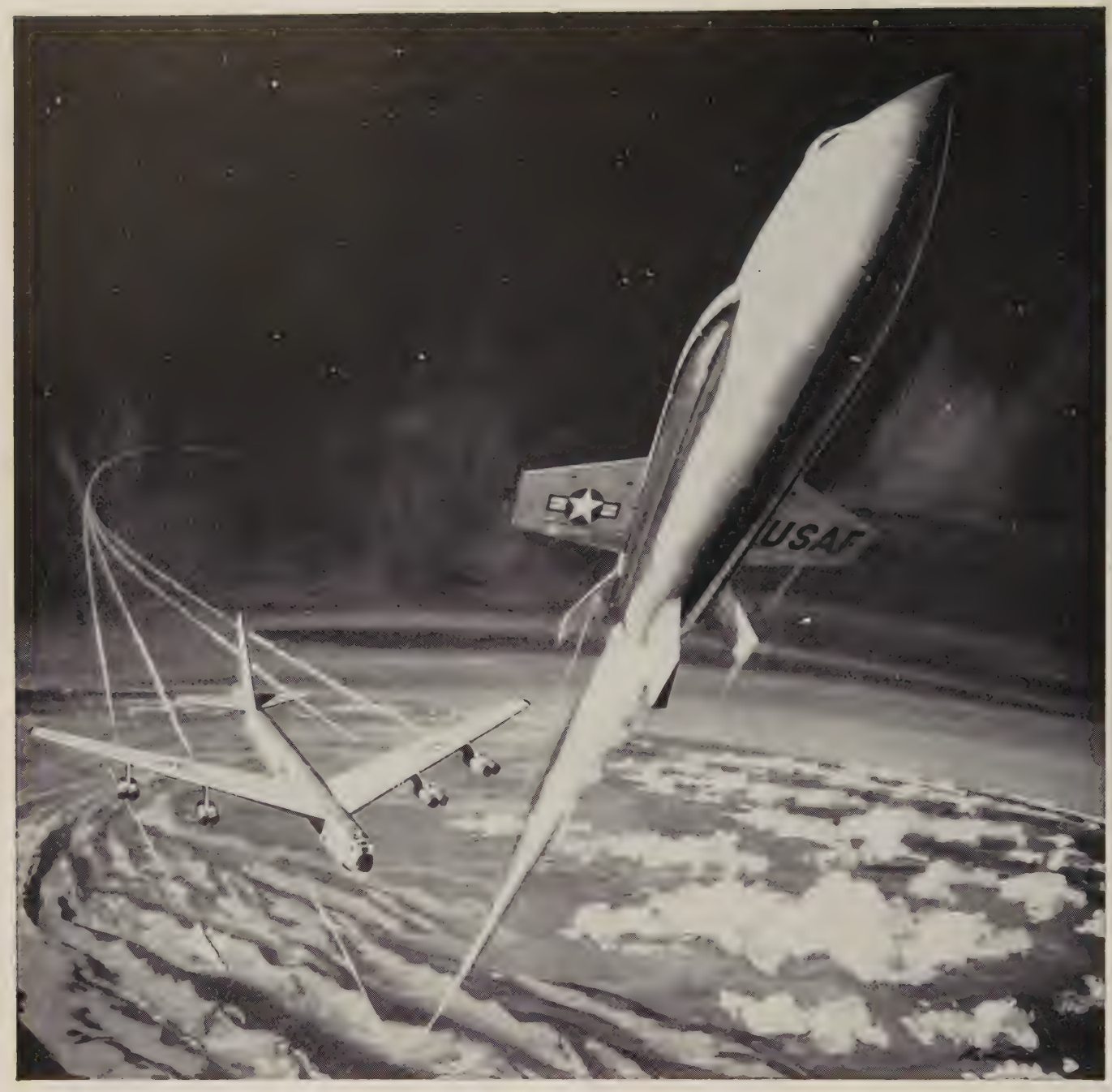

X-15 AWAY

. . . TARGET: 100 MILES UP! On a day surprisingly soon 45,000 feet above Wendover, Utah, North American's rocket-powered X-15 research plane will be released from a modified B-52 to take man 100 miles into outer space. Throughout the flight trajectory, radio contact between the X-15, the mother ship, chase planes and the ground will be maintained by custom-designed units from a Collins CNI (communication, navigation, identification) system, similar to the electronic packages Collins is providing for the new military jet aircraft.

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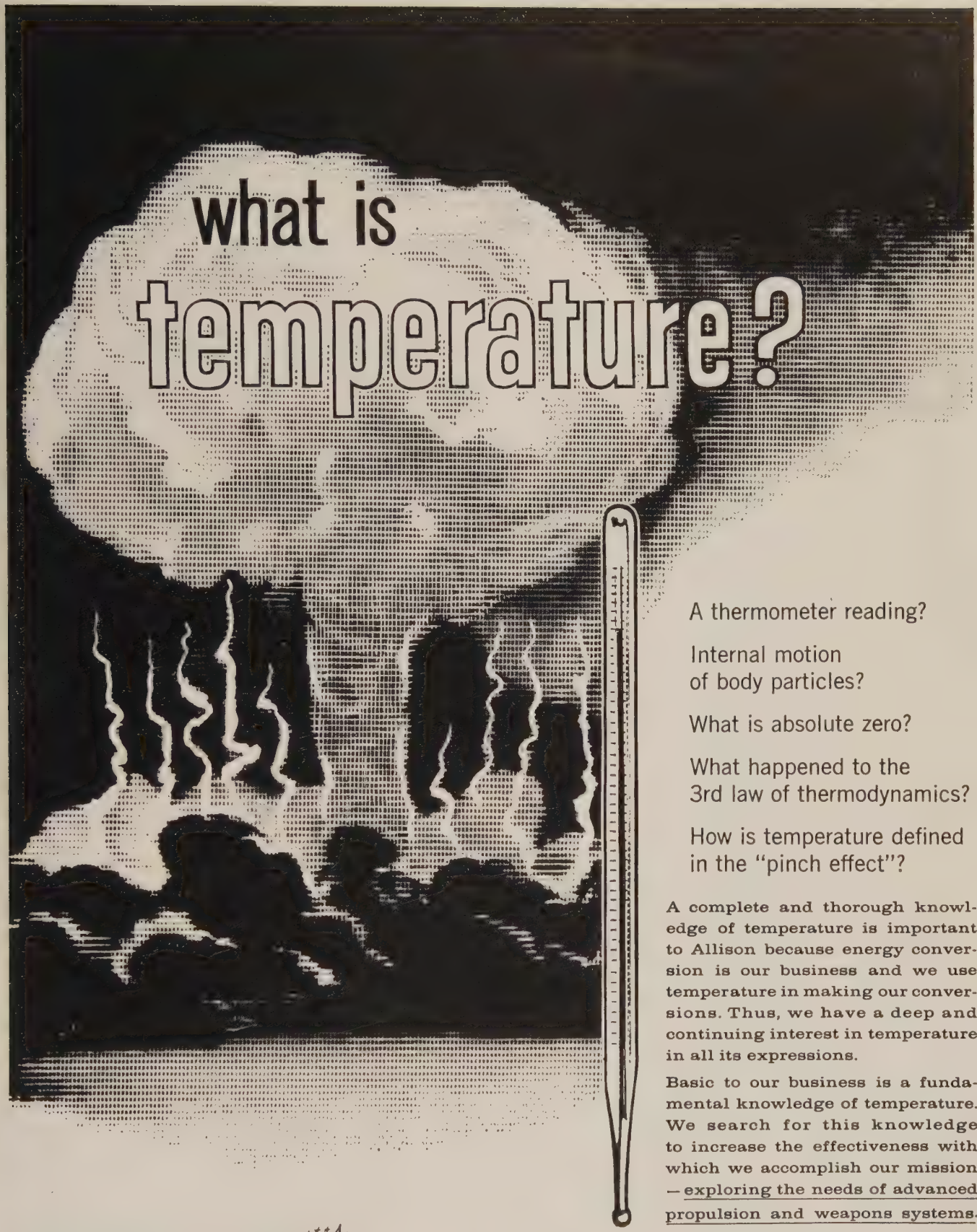

A thermometer reading?

Internal motion
of body particles?

What is absolute zero?

What happened to the
3rd law of thermodynamics?

How is temperature defined
in the "pinch effect"?

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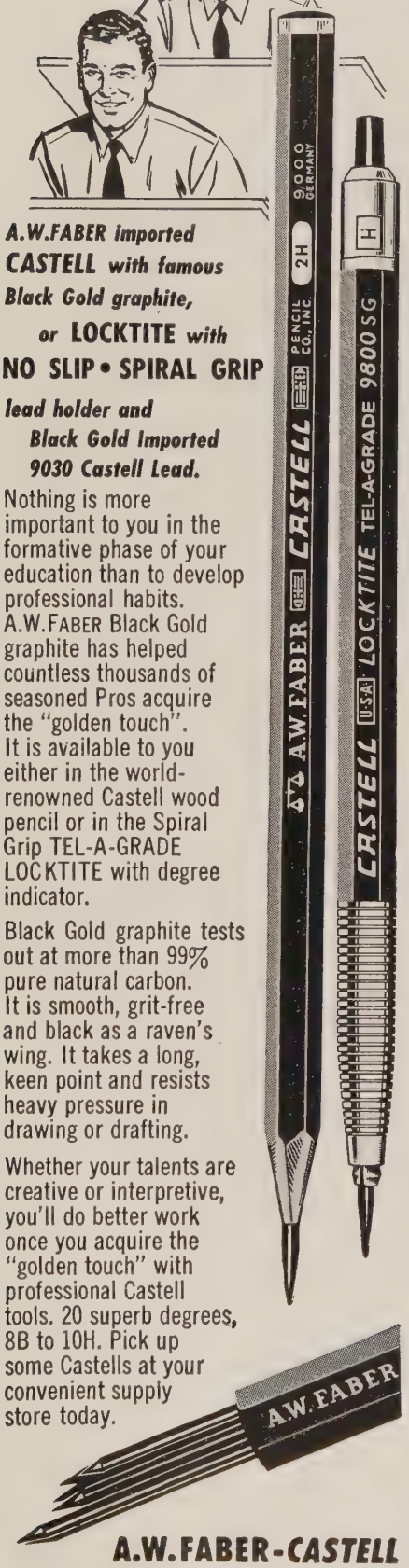


A.W.FABER-CASTELL
PENCIL CO., INC. NEWARK 3, N. J.

(Continued from Page 32)

flashtube in its reflector. A third receptacle is provided for the connection to the camera shutter synchronizer. The main switch, power pilot light, and charge pilot light are usually mounted on the cover of the power pack.

The charge indicator is a handy auxiliary. It is set to glow when the capacitor is about eighty per cent charged. This not only signals when the unit is ready to flash on a full capacitor, but acts in portable battery units as a warning of battery condition. When the charge light takes longer than normal to glow, it is a sign the battery is approaching the end of its charge.

The high speed of the electronic flash "freezes" the water. (1/2000 sec.)

What makes electronic flash units advantageous over other types of lighting sources?

The advantages of electronic flash in motion-stopping photography are obvious, but other features including high intensity and the fact that the flashtube may be used for 10,000 or more flashes at a very low operating cost, are also matters of great importance to most photographers. The low cost per flash is possible because the maximum power consumption, which may be about 500 watts for an average studio unit, is used only during the few seconds in which the condensers are being charged. The piercing light and great heat radiation of photoflood lamps have often been found objectionable. The quick flash of a speedlamp makes heat and light almost unnoticeable. This is particularly useful in photomicrography, where a short exposure is necessary to stop the motion of living microorganisms, but where the heat of ordinary tungsten or arc illuminants might kill the specimens.

The color quality of all speedlight illumination closely approximates that of daylight—quite bluish as compared to the tungsten illuminants ordinarily used indoors.

The quality of the flashtube illumination is soft, and the intense brief flash has great penetrating powers. There is less tendency than photoflash to burn up foregrounds; more light is carried into backgrounds, and the texture of hair or fur is rendered excellently.

The principal disadvantage of the electronic flash is its relatively high initial cost. Well made sets may run into hundreds of dollars and the less frequent user will not find these units economical.

Those who have become accustomed to flashbulbs know well that each size of these packaged light sources carries a so called "guide-number." Following the number, it is next to impossible to get a wrongly timed negative. The speedlight's performance, however, depends upon the magnitude of voltage on which it is operating. If the unit is made for, say, 110 volts to give a certain guaranteed amount of light, it will give 21 per cent more light at only ten per cent more voltage (rise and fall of the light is proportional to the square of voltage). House voltage variations of plus or minus 10 per cent are not uncommon.

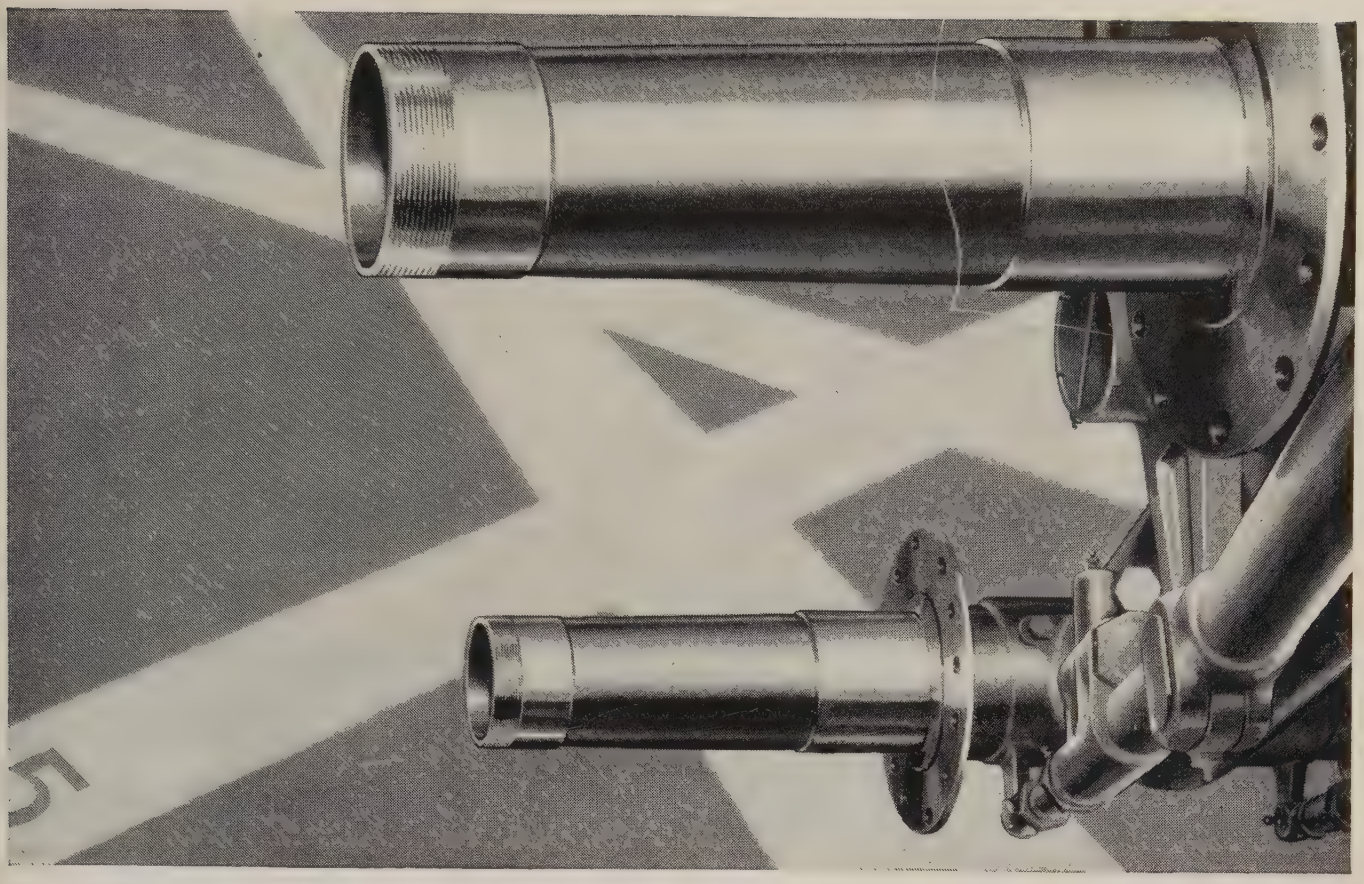
Flashtube light output is actually in proportion to weight and bulk. In other words, the more light desired, the larger the unit needed (quality and light beam spread being equal). This is not very important in studio units, although it can be a problem with portables.

The high speed of the flash from an electronic flash unit produces an effect on film which is called reciprocity failure. The reciprocity law for film states that the exposure is equal to light intensity multiplied by the time. However, a departure from this law starts to occur when the exposure duration is less than approximately 1/500 second. As the duration is reduced, departure from the law becomes apparent. The emulsions lose speed and contrast. All films do not react in the same way to extremely short exposures. The speed relationships between films are not the same with electronic flash as they are with other illuminants. Under high-speed flash a "slow" film may become a "fast" film.

Obviously, electronic flash units are not yet the solutions to every problem faced by the photographer. Gradually these units will be improved. Literally and figuratively, electronic flash is the "lively light with a brilliant future."

New Car Battery

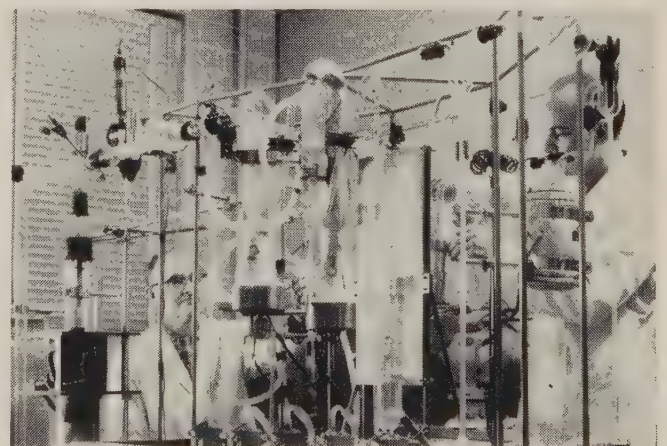
A new car battery, scheduled for introduction this fall, features individually removable plastic cells, reports Product Engineering. The advantages are: (1) defective cells can be replaced at moderate cost; (2) freer flow of air around the cells is possible, minimizing the danger of overheating.



How to get steel tough enough to land America's first jet airliner

YOU see above the axles of the Boeing 707—America's first jet airliner. They have to be tough. A cross-wind landing could put the whole landing impact of this 122-ton plane on one wheel—instead of eight. And these axles have to be light. Manufacturers of the 707's landing gear had built landing gears for dozens of other models using an analysis of seamless steel tubing specially developed by the Timken Company. But to be strong enough for the much heavier 707, the steel would have to be cleaner. Any impurities in the finished part would cause its rejection. Timken Company metallurgists said the steel *could* be made clean enough for the 707. And it was—met highest specifications, stood up to the terrific landing impacts.

Timken steels have solved the toughest steel problems. Problems that you may face in your future job in industry. Our metallurgists will be ready to help you. And if you're interested in a rewarding career with the leader in specialty steels . . . with the world's largest maker of tapered roller bearings and removable rock bits . . . send for free booklet, "Better-ness and your Career at the Timken Company". Write Mr. Russ Proffitt, The Timken Roller Bearing Company, Canton 6, Ohio.



Vacuum Fusion Laboratory in our new steel Research Center, where small samples of new steels are analyzed—steels to answer today's problems, tomorrow's needs.

TIMKEN® *Fine Alloy* **STEEL**

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

Deep Water and Deep Space open up Exciting Careers at Chance Vought

Outer space and ocean depths present a tremendous challenge to young engineers. Deep space and deep water are becoming new avenues of attack, and consequently broad studies are now going on at Chance Vought for safeguarding these approaches with advanced weapons systems.

Toward space security, Vought's propulsion specialists are analyzing nuclear and ionic power. Astronautics design teams are studying crew quarters for spacemen and devices for escape from orbit . . . drawing on the near-space cockpit and capsule experience of Vought's *Crusader* fighter developers.

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Engineers of all academic specialties can find at Vought an unmatched career area . . . as new capabilities are forged . . . weapons for deep water and deep space defense.

CHANCE VOUGHT AIRCRAFT
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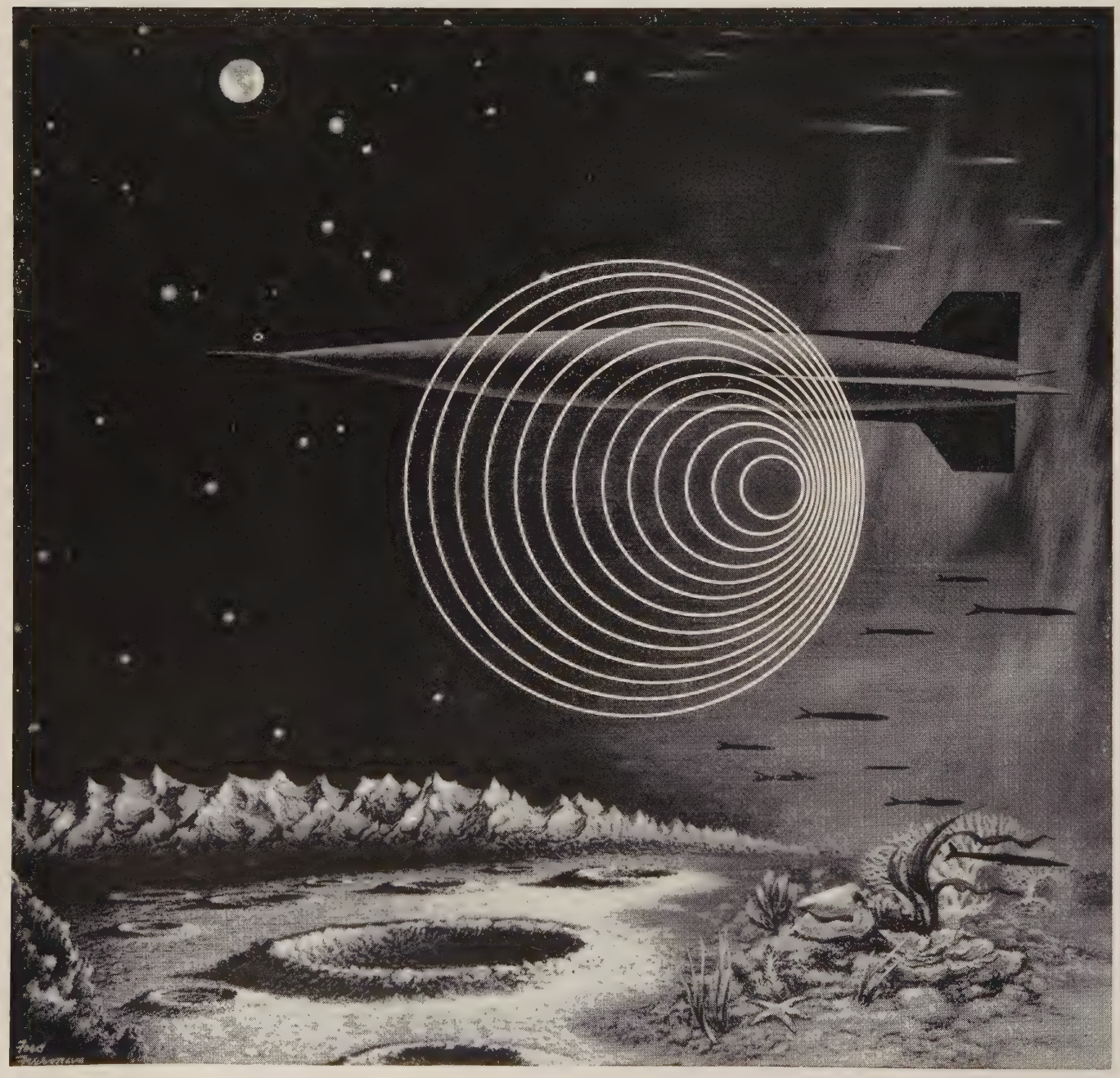

from Deep space to Ocean floor

Vought offers this range to the young engineer

At Chance Vought the engineer's assignments range from the depths of the ocean to the farthest reaches of space . . . from hardware operating aboard the Navy's nuclear-armed submarines to space research vehicles still on the boards.

Here the engineer contributes to projects such as the record-smashing *Crusader* jet fighter series . . . the *Regulus* missiles . . . and advanced weapons, details of which are still classified.

Under the guidance of the Vought engineer, such weapons take shape. He supervises critical tests, and he introduces the weapons to the men with whom they will serve.

Engineers with many specialties share these experiences. Today, for example, Vought is at work on important projects involving:

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Dept. CM-13

CHANCE VOUGHT AIRCRAFT
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(Continued from Page 15)

made by Nortronics Division of Northrup Aarcraft, Inc., rides on the tip of the nose cone. Sensing pressure differentials, the Q-Ball, as it is called, gives the pilot important information upon the correct re-entry angle. The first flights will be made without the Q-Ball, however, as the device will not be ready in time for the initial tests.

The plane is extensively instrumented and is closely tracked by ground installations. About six hundred temperature pickups and 140 pressure devices are placed in strategic spots in the plane. Small radar amplifiers are carried in order that ground radar can track the vehicle at hundred mile altitudes. The tracking stations mentioned have been built along the flight path at a cost of twenty million dollars.

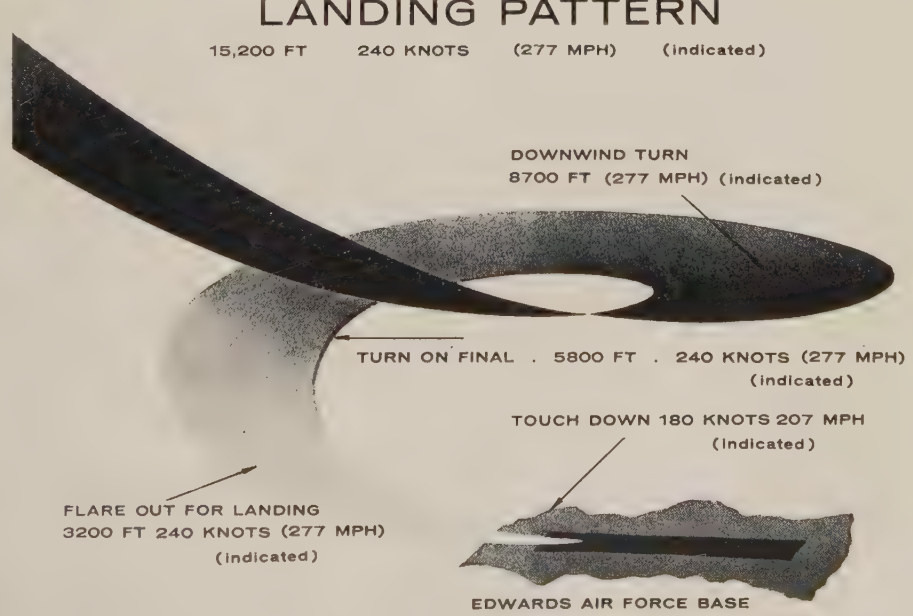
A painstakingly designed pressure suit will protect Crossfield on his flight. Covered with a heat reflecting material, the suit is pressurized and cooled by expanding liquid nitrogen through it. The nitrogen which is exhausted from the suit is used to pressurize and cool the instruments. Positive flow of nitrogen is assured by the use of pressurized helium to propel the liquid. In addition to this main pressurizing system, a back pack of oxygen and nitrogen provides emergency facilities. Attached to the suit and the pilot's body are sensors which record and transmit data to the ground concerning respiration, heart beat, suit pressure, and suit temperature during the alternate periods of high acceleration and zero gravity. The helmet is kept at a slightly higher pressure to insure the adequate passage of oxygen into the blood stream.

The cockpit is small but functionally designed. Narrow windows extend along the sides of the cockpit providing some side visibility. Since the earth's atmosphere is too thin at high altitudes to diffuse the sun's rays, artificial interior lighting is provided to soften out the abrupt transition between sunlight and shadow. Special insulation protects the cockpit and pilot if, by some mischance, the heating rate should become excessive. Just behind the pilot's head is the instrument bay which houses the inertial guidance system.

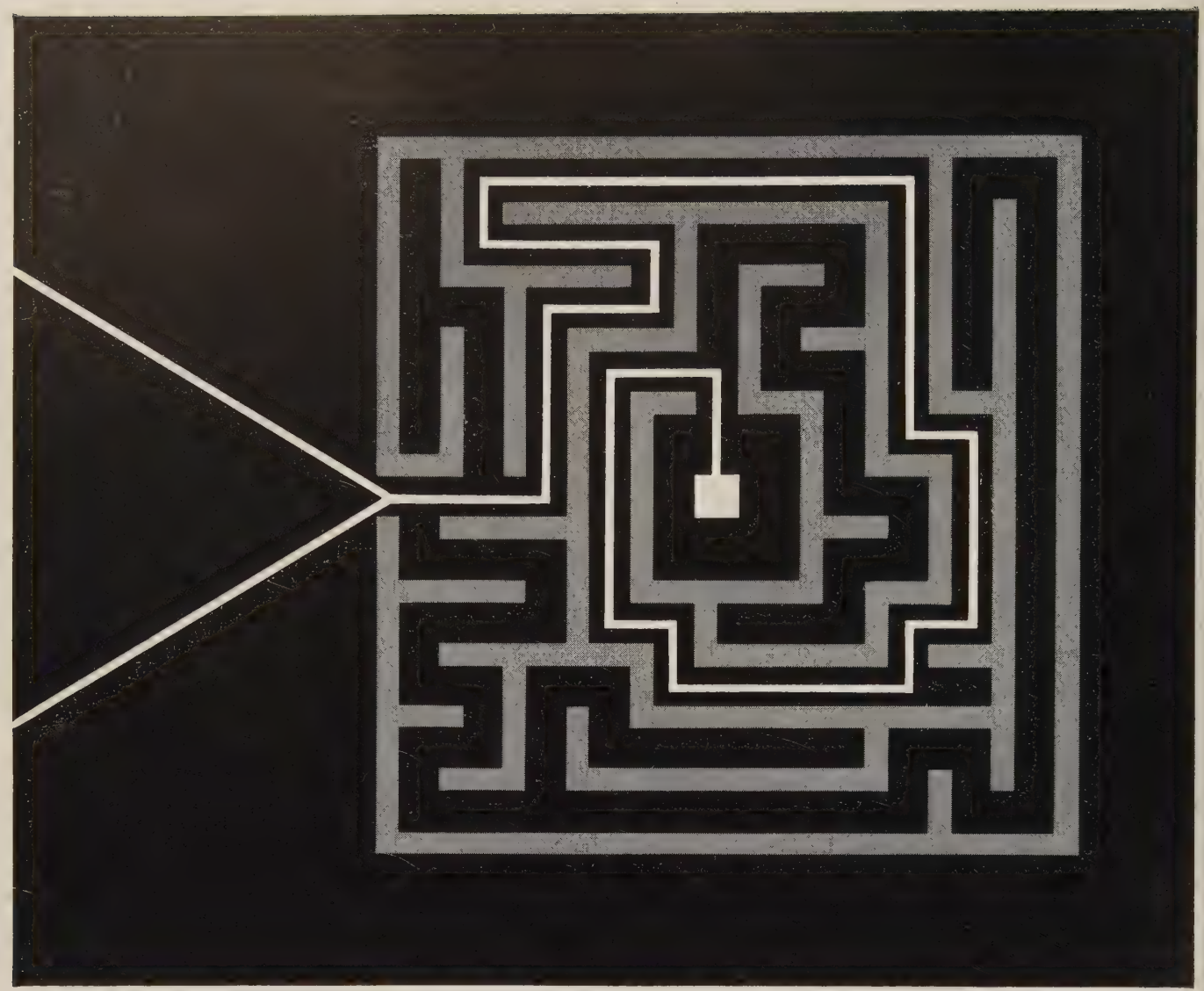
In the event anything goes wrong during the flight, an elaborate escape system provides a means of survival for the pilot. In an emergency the plane would be ridden down to lower altitudes, the tremendous buffeting forces being absorbed by it. When the plane is traveling sufficiently slow and is low enough, the pilot can eject himself and the seat from the plane. He and the seat are enclosed in a capsule which has stabilizing fins to prevent tumbling. At a predetermined altitude the pilot is automatically ejected from the capsule, and descends to earth by means of his parachute which also is automatically opened. As in all designs, certain compromises had to be made in the escape system in order to achieve a compatibility between safety and weight requirements.

After many captive tests, slung under the wing of a B-52, to check out the performance of the instruments and controls, and after several powerless drops are made, the day for the first powered flight fiinally arrives. The X-15 is fueled and loaded onto the bomber. The B-52 roars down the runway at Wendover Air Force Base in Utah and begins its long climb to forty thousand feet. Crossfield and the crew spend their time

(Continued on Page 42)


LANDING PATTERN
15,200 FT 240 KNOTS (277 MPH) (indicated)
DOWNWIND TURN
8700 FT (277 MPH) (indicated)
TURN ON FINAL . 5800 FT . 240 KNOTS (277 MPH)
(indicated)
TOUCH DOWN 180 KNOTS 207 MPH
(Indicated)
FLARE OUT FOR LANDING
3200 FT 240 KNOTS (277 MPH)
(indicated)
EDWARDS AIR FORCE BASE

—Drawing Courtesy of North American Aviation, Inc.



A RESUME IS A TWO-PARTY AFFAIR

Throughout your engineering career, the name of the first employer appearing on your resume can be as significant as your education. But, in selecting that first employer, you should also consider his resume.

ITT is the largest American-owned world-wide electronic and telecommunication enterprise. To give you an idea of the breadth of our activity . . . there are 80 research and manufacturing units and 14 operating companies in the ITT System playing a vital role in projects of great national significance in electronics and telecommunications research, development, production, service and operation.

The scope and volume of work entrusted to us by industry and the government opens a broad range of highly diversified engineering and technical positions in all areas of our work . . . from tiny diodes to complex digital computer systems and a massive network of global communications.

In addition to the opportunities for work and association with distinguished engineers and scientists, our graduate education tuition refund program encourages engineers to continue their formal training . . . and the facilities for graduate work near ITT locations are superior.

This is an all too brief resume. It would be hard to associate yourself with a company that offers the engineer greater choice of assignment. Write us about your interests — or see our representatives when they visit your campus.

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because efficiency is a part of the over-all design

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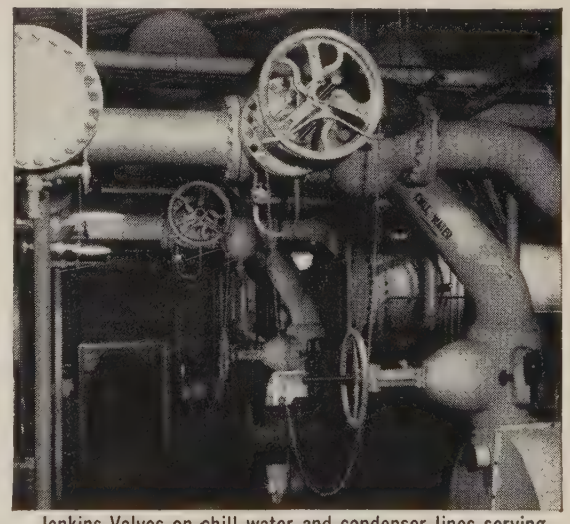
With efficiency a part of the over-all design it is not surprising to see Jenkins Valves on the plumbing, heating and air conditioning pipelines in this superb building. For almost a century the name JENKINS has meant reliability . . . valves with the enduring quality to last the life of a building. It will pay you to have this important assurance when you specify or install valves, especially since Jenkins Valves cost no more. Jenkins Bros., 100 Park Ave., N.Y.17.



Jenkins Valves on chill water and condenser lines serving Ford building's 2,200-ton air-conditioning system.

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(Continued from Page 39)
making the pre-drop checkouts which are so important to the success of the experiment.

When the B-52 reaches the required altitude, it turns westward towards Edwards Air Force Base, California, and accelerates to top speed. At this point the X-15 is dropped free of the mother plane. Crossfield then pushes the firing button, and the rocket flares into life. The craft begins to accelerate and gains speed rapidly. Using the right hand stick, the pilot pulls the plane into a steep climb. Crossfield is under heavy inertia forces at this time, and the controls are conveniently close to his fingertips, his arms being supported by padded arm rests. After ninety seconds of burning, the rocket engine dies, its fuel exhausted. By this time the X-15 is about twenty miles high and is travelling around three thousand miles per hour. The instant the rocket burns out, the weight of the pilot in respect to the plane drops to zero.

Silent now, the plane obeys Newton's laws of motion exactly and continues to rise in a parabolic trajectory. In the meantime the instruments are recording and transmitting data back to the ground tracking stations. The total time taken to fly the arc is approximately five minutes. If Crossfield cares to look out the windows at this point, he would see an inky black sky studded with brilliant stars. The sun would be a white hot ball, unbearaly bright to look at.

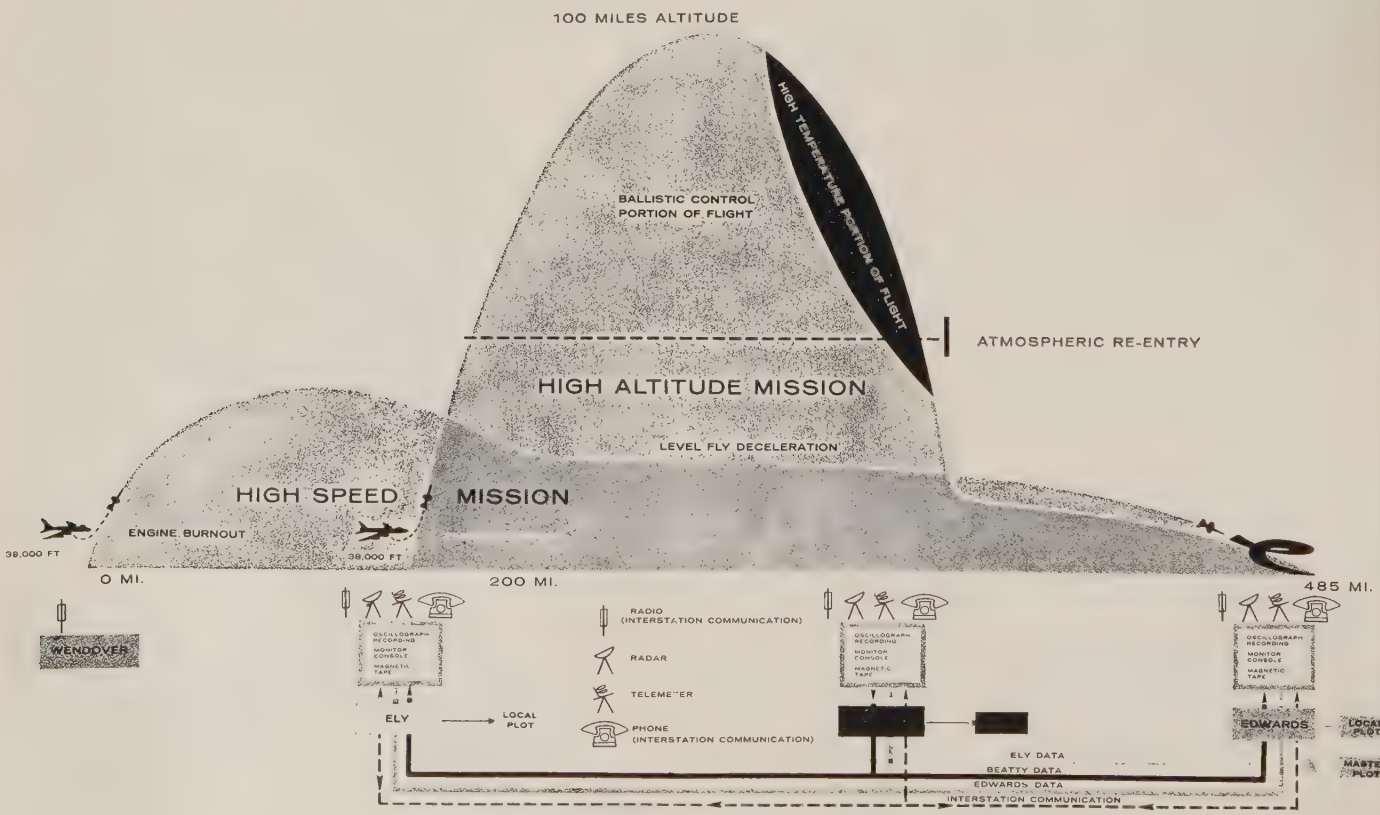
After the brief hesitation at the top of its arc, the plane begins its downward plunge into the earth's atmosphere. A wrong move during this critical re-entry portion can turn the plane into an expensive flaming meteor. Two schools of thought exist on the re-entry method. One claims that a constant plunge into the atmosphere is best, while the other claims that a skipping back and forth in and out of the atmosphere results in less heating. The skipping method is the one decided upon, but the exact procedure has not been revealed. As temperatures along the skin shoot up to 1000° F., the air conditioning is working at full capacity to keep the pilot and instruments cool. Crossfield relies heavily upon his guidance system to enable him to select the proper re-entry angle.

After the re-entry phase of the flight the rest is fairly routine. Escorted by a chase plane, the X-15 glides to Edwards AFB to land. A total horizontal distance of four hundred miles has been covered during the twenty minute journey. Just prior to landing, the pilot jettisons the verticle stabilizer, and the landing gear drops into position. Touching down at two hundred miles per hour, the X-15 completes its historic trip.

After the initial flight, which is termed a potentiality test, the craft is turned over to the Air Force which will run dozens of similar tests with it. Little attention will be drawn by the plane after its first flight, but the knowledge gained from the tests will be an invaluable aid in hastening the day of manned space flight. The X-15 is truly the link between conventional aircraft and space ships.

X-15 HIGH RANGE

Typical high speed and high altitude missions of the X-15 over the Air Force/NASA High Range, showing radar and telemetry recording process, with flight safety monitor console, and UHF air/ground communication system.



—Drawing Courtesy of North American Aviation, Inc.

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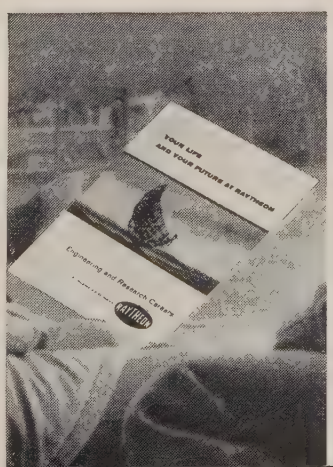

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IMPORTANT DEVELOPMENTS AT JPL

SIGNALS FROM VEHICLES IN SPACE

The exploration of outer space has taken a new step forward with the completion of the new giant radio antenna which has recently been installed by JPL at Goldstone near Barstow, California. This huge "dish," 85 ft. in diameter, enables the Laboratory scientists to probe still farther into space problems.

The Goldstone antenna is presently tracking rocket probes far out in space. Information thus obtained from Explorer satellites and Pioneer space probes is being reduced and studied to provide invaluable basic data for future space programs.

The Goldstone link from space to earth will be extended from the present range of 500,000 miles to many times that figure, bringing the planets Mars and Venus within its reach.

This activity is part of the research and development program operated by JPL for the National Aeronautics and Space Administration.

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A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

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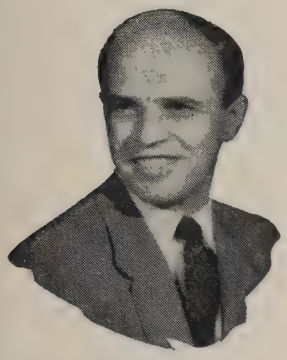
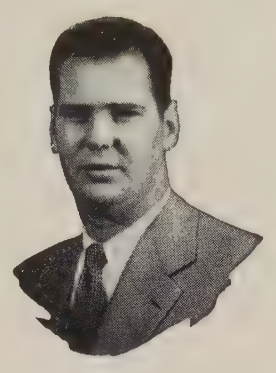
Allis-Chalmers offers training course

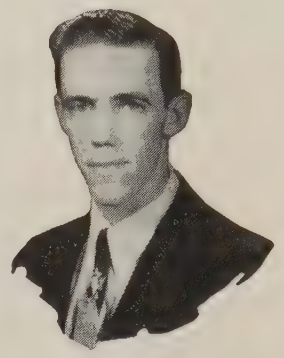


In nucleonics, Andrew Selep, Brooklyn Polytechnic Institute, BME '53, is working on the problem of reactor safeguards.

Special engineering by Paul W. Clark, Iowa State College, EE '49, is of large job involving combined electrical equipment.



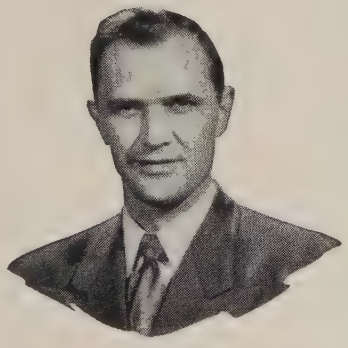
Sales manager, Robert Horn, Marquette University, EE '51, heads sales of voltage regulators used on power lines.



Electronics man, William E. Martin, Alabama Polytechnic Institute, BSEE '53, engineers applications of induction heaters.

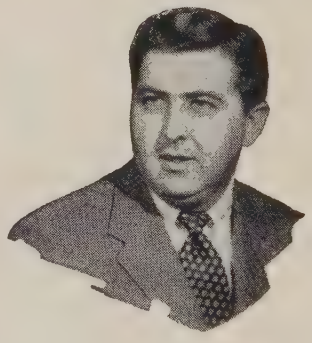
plus wide choice of type and fields of

Design of generators for steam turbines is directed by G. W. Staats, Illinois Institute of Technology, Ph. D. '56.



Field sales of America's widest range of industrial equipment is career of Carl E. Hellerich, U. of Nebraska, ME '49.

Promotion man, Robert I. Carlson, Worcester Polytechnic Institute, ME '50, directs promotion of switchgear, and substations.



Application and sales of steam condensers for power plants are handled by William E. Ellingen, U. of Wisconsin, ChE '49.

work on equipment for many industries

THE outstanding training course started by Allis-Chalmers has proved a springboard to many worthwhile careers In fact, most of the A-C management team has stemmed from its ranks.

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Don Walter, B.S.M.S., achieved an outstanding academic record at Cal Tech, Class of '40, while earning seven varsity letters. Today as Vice President in charge of Engineering and Van Nuys Operations, Don utilizes his technical and teamwork background to lead Marquardt's engineering and development manufacturing.

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merson Memorial Fund

Colleagues, friends and former students of the late Dr. Robert Emerson, University of Illinois professor of botany, are establishing a memorial fund n his honor to provide financial assistnce to graduate students working in he allied fields of photosynthesis, physcs, chemistry, and/or biochemistry.

Prof. Emerson, world-famous for research on energy transformation in photosynthesis, was among victims of the Feb. 3 airplane crash in New York's East River.

Anyone wishing to contribute to the Robert Emerson Memorial Fund should send donations to University of Illinois Foundation, 226 Illini Union, Urbana, Ill.

The committee establishing the memorial fund is composed of Prof. Lindsay M. Black, department of botany; Prof. David G. Bourgin, mathematics; Prof. Gottfried Fraenkel, entomology; Prof. John R. Laughnan, botany; Prof. F. Wheeler Loomis, physics; Prof. William H. McPherson, economics; Prof. George C. McVittie, astronomy; and Prof. Eugene I. Rabinowitch, botany.

Summer Courses at IIT

Two special courses in x-ray diffraction analysis will be offered again this summer at Illinois Institute of Technology.

They will be one-week sessions and are scheduled as follows: The Powder Method in x-ray Analysis, June 8-12 and Advanced Methods in x-ray Analysis, June 15-19.

Specifically, the courses are designed to provide training in the utilization of x-ray diffraction methods in the analysis of commercial materials. The full-time day classes will include lectures and laboratory work. The latest powder camera equipment and counter diffractometers will be used.

No prerequisites are required for the non-credit courses, which will be limited to 12 students. Information on tuition fees and on-campus housing facilities can be obtained from Dr. Leonid V. Azaroff, Illinois Tech, Technology Center, Chicago 16.

Hitler's Gift for Sale

More than a dozen Doric columns were left standing in the yard of a German stone-cutting firm when the roof fell in on Adolf Hitler and Benito Mussolini, reports Engineering News-Record. They are still standing there, and the firm would like to sell them—cheap. Hitler ordered the 50-foot columns as a gift for Il Duce some 20 years ago, but payment and delivery were never made.

Westinghouse-proposed solar sail may permit 60,000 mph speeds in space... and it will need no fuel at all!

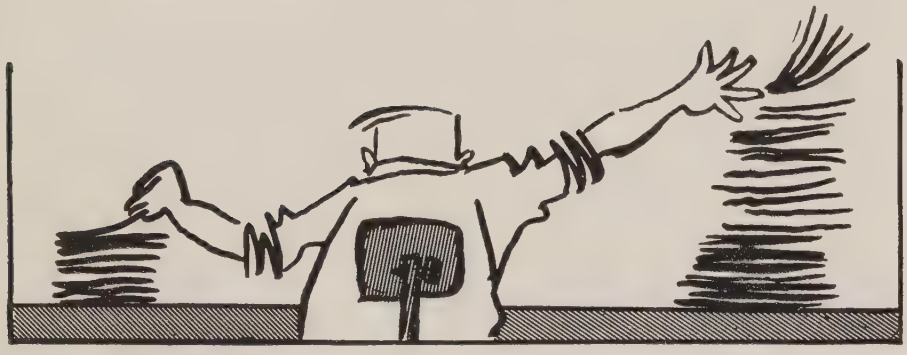
Lunar reconnaissance—and manned lunar colonies—may become realities in the not-too-distant future.

But the exploration of deep space is entirely another matter. Distances are tremendous—fuel requirements for chemical rockets are staggering—navigation must be almost unbelievably precise.

As a partial answer to these problems, a Westinghouse scientist has proposed the use of a solar sail which will harness the light of the sun. This sail will require no fuel, it will be capable of fantastic speeds, and its design will permit in-flight navigational corrections. More important, this Westinghouse approach could be cheaper and simpler than any other system proposed for this same purpose.

YOU CAN BE SURE...IF IT'S Westinghouse

Skimming Industrial Headlines



Edited by The Staff

Starfighters for West Germany

Lockheed Aircraft Corporation's California Division today received official notification of the signature of contracts for the purchase of 96 F-104 Starfighters by the West German government.

Deliveries are scheduled to begin at the end of this year. Initial aircraft will be 30 two-place trainers, followed by 66 advanced single-place multi-mission combat planes to serve as fighters, fighter-bombers, and reconnaissance aircraft.

The 96 aircraft will be produced in Lockheed's facilities in Burbank and Palmdale, Calif.

Another 200 will be manufactured in Germany by the "Sud-Gruppe" (Southern group of aircraft manufacturers) which includes Dornier, Messerschmitt and Heinkel, according to official reports in Bonn.

The Starfighter holds the world speed record (1404 mph); the world altitude record (91,243 feet); and seven time-to-climb records.

Disclosing the decision in principle to buy F-104s recently, Defense Minister Franz Josef Strauss stated: "The Starfighter answers Germany's specific needs. The double-sonic jet is powered by the General Electric J79 engine which delviers 15,000 pounds of thrust.

Production of F-104 Starfighters at the company's plants in Burbank and Palmdale will extend into 1962 as a result of West Germany's announced program to procure an advanced version of the double-sonic fighter.

Instrument Rental Service

Science and engineering instructors in schools and colleges now have a new and inexpensive way of obtaining a variety of instruments for demonstration and experimentation.

The General Electric Company has announced establishment of a pool of 13,000 instruments which it will rent in the first large-scale, nationwide rental program of its kind.

Organized through the Company's cross-country network of 55 Service Shops, the new program offers instruments for more than 70 different kinds of measurement at monthly rental fees ranging from $1 to $96. Average monthly rental cost is $16.

The devices available range all the way from a $2,500 multi-point temperature recorder to a pedometer to measure the distance an individual covers on foot.

C. E. Sutton, marketing manager of the Service Shops Department, said the service should prove especially attractive to educational institutions. "Purchase of this equipment—some of it highly specialized—can prove extremely costly unless it is for use over long periods," he said.

Sutton observed a deluxe oscilloscope, for occasional use, costs $1,500, but can be rented for less than $75 a month, including maintenance.

Other rental instruments include microscopes; numerous recording devices and other instruments which measure virtually every electrical or mechanical quality; special instruments such as leak detectors, temperature gages, flowmeters, pressure recorders and thousands of other measuring devices in more than 200 different "families" of instruments.

Representing an investment of several million dollars, the instruments may be rented through any of the Company's local service shops, or through its Apparatus Sales offices.

Auxiliary services include instrument calibration and standardization, design and manufacture of special instrument prototypes, an instrument repair service and a consultation service on instrumentation systems.

"Sky Master" Lathes

The missile and rocket design and manufacturing field is pushing machine tool builders in two directions at the same time. One is toward smaller precision machines to produce smaller and smaller internal missile parts. The other direction is toward huge machines which will produce bigger and bigger components such as missile and rocket housings to high precision. An example of the second is the introduction by Sidney Machine Tool Company, Sidney, O., of a line of "Space-Master" lathes designed to machine parts up to 50 feet long and up to 12 feet in diameter.

Floating Grass Cutter

A floating grass cutter is giving golf greens a close, even shave. The mower is built so it floats in front of the engine and is not affected by motor vibration or operator technique. Its seven rollers and two runners reduce ground pressure, protect golf greens and follow contours without gouging or digging into the lawn.

Steel Butterfly

A German engineer, by imitating the structure of a butterfly's wing, has developed a light, highly rigid design for steel panels that has nearly 20 per cent more resistance to bending than similar designs. The panels are made of two thin sheets of metal imprinted with "dimples" and fastened together where the dimples meet by spotwelds. In cross section, the panels closely resemble a butterfly's wing.

Real Cool Finish

A new—real cool—finish called "Fro-Zon" is now being applied to stainless steel, giving the shiny metal a frosty appearance.

Developed by Stamping Service, Inc., of Detroit, Mich., the new finish is being used on automobile trim sec-

tions of stainless steel supplied by Allegheny Ludlum Steel Corporation.

The new finish is made possible by a type of "semi-blasting" technique which gives the metal a frosted look by forming tiny mounds on the surface of the metal. This process, which is put on very lightly and does not penetrate the surface of the metal, diffuses light rays and gives the frosted appearance.

All kinds of patterns, lettering, bossed, deposed, flat or contoured surface, can be handled by the new process. Also, the finish is applied after the stainless steel part is formed.

At the present time the company has done work only in the automotive industry, but expects to take this process to other fields shortly. The developers are aiming at the home appliance, architectural, furniture, toy and related fields. Cooking utensil manufacturers are expected to be interested in the new finish, too.

Engineers will not disclose the method of applying the unique finish. They report that they can put it on any size, shape, type or gauge of a shiny surface of stainless steel. They have done most of their work on Type 430 stainless steel. This is the type used in the automobile industry for window trim, side and body mouldings and numerous other trim and functional parts of today's outomobile.

Neither heat nor cold has any effect on the surface treatment, and under accelerated field tests weathering doesn't seem to have any effect either.

The Detroit company is also working on coloring with the new process, and reports that it expects to have an announcement on this shortly.

Stereo to Bring New Hi-Fi

The wide interest in stereophonic sound should boost high fidelity components to a dramatic growth record in 1959. The industry should top its 1958 dollar volume by more than 30 per cent.

Most of this growth will result from sales of stereo components, as 1959 will be the first full year when all types of these components will be generally available. Stereo components generally will bear higher price tags because of their specialized nature.

The industry also faces the new challenge and opportunity to educate consumers on the basic technical points of stereo hi-fi. Such education will enable consumers to derive maximum performance and listening pleasure, and thus will contribute to further healthy growth of the market.

Westinghouse Astronautics Institute now probing basic problems of interplanetary travel

It was a wise man who first said, "A problem well defined is half solved."

Space exploration is no exception to this rule. Many of the complex activities at Cape Canaveral and our other missile test sites are devoted to better defining the problems involved in space flight.

Westinghouse, for its part, has established an Astronautics Institute to investigate such matters as space craft stabilization, orbital injection, space guidance and communications, the equipment needs of a manned lunar colony, etc. This Westinghouse group has already made significant contributions toward a better understanding of space problems. It has also developed a number of solutions.

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS-TV MONDAYS

There's much more to it than just the size of the FISH and the size of the POND

O

We've been told that an engineering graduate is frequently attracted to companies our size because of his understandable human desire to be "a big fish in a little pond".

While it is true that (numerically speaking) our employee team is small compared to some, we encounter great difficulty in trying to think of Sikorsky Aircraft as a "little pond". Our contributions to the field of rotary-winged aircraft have not been small, nor can our field be considered limited or professionally confining. Quite the contrary. Sikorsky Aircraft is the company which *pioneered* the modern helicopter; and our field today is recognized as one of the broadest and most challenging in the entire aircraft industry.

And what of the size of the "fish"?

Unquestionably, that is a matter involving your own individual potential for growth. Like any far-sighted company, we're always willing to talk with "young whales"!

For factual and detailed information about careers with us, please write to Mr. Richard L. Auten, Personnel Department.

SIKORSKY AIRCRAFT

ONE OF THE DIVISIONS OF UNITED AIRCRAFT CORPORATION

BRIDGEPORT-STRATFORD, CONNECTICUT

'Beaver-Napers' Plan Assault

Canadian construction men are planning some mass beaver-naping after losing three battles to a colony of 30 amphibious rodents. Three times, construction men tore down a beaver dam to relieve flooding of a quarry. Each time the beavers repaired the gap in their home. Now the men plan to kidnap the busy beavers and let them do their dambuilding elsewhere.

Stainless Steel Muffler

The second change in auto mufflers after years of stagnation may come close on heels of the first. After introduction of anti-corrosive coated steel elements on the 1959 models, at least one company now has come out with a stainless steel muffler. The muffler, it is claimed, can be made considerably smaller than standard types and produced in stainless steel at a competitive price with the coated steel models, if not with the old bare-steel models.

Transistor Sales Up

Sales of transistors this year will jump 40 per cent over last year and probably hit 73 million units in 1959. About 10 per cent will go into electronic computers, some of which require 70,000 transistors each.

Multi-Object Tracking

Equipment that will track the paths of five aircraft of all types simultaneously within a radius of 200 miles and with an accuracy to within five feet has been developed by a West Coast company. The company also claims that additional gear could give the system a capability of monitoring more than 400 aircraft at once.

Russian TV Flops

A campaign to sell Russian television and radio sets has reportedly been cancelled by Czechoslovakia's Communist Party. The reason: the TV sets are so delicate that special shops had to be established to handle all the repairs and the radios, which can only receive Moscow and Czech stations, are often faulty and cannot be fixed for lack of parts.

Built-In Bomb Shelter

A Phoenix homebuilder offers a 10-by-12 foot basement bomb shelter as standard equipment in his $45,000 and $50,000 homes. The shelters are enclosed on top and sides with 10-inch reinforced concrete. Ceilings are eight feet high. The developer says the shelters' steel doors will not blow out.

Westinghouse develops new skin for space craft... so they won't burn up re-entering earth's atmosphere

At 6,000 mph, air friction is a problem for space craft re-entering earth's atmosphere, because skin temperatures can exceed 2,500°F. Without adequate thermal protection, the incoming space vehicle will burn itself up like a meteor.

Westinghouse has developed a new ablative material for use as the protecting outer skin for space craft. It has already been service-proven in actual re-entry tests involving firings of ballistic missiles equipped with nose cones of this material.

This new Westinghouse development should do much to help advance our nation's space exploration effort.

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS-TV MONDAYS

STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

You may wonder what the future holds for the engineer who decides to build his career in the aircraft/missile industry.

In terms of permanent demand, this industry probably requires a greater proportion of engineers to total personnel than any other. Here at Douglas we are now employing more engineers than we did during World War II.

In regard to professional standing, the aircraft/missile industry deals always with the latest state of the art in every engineering and scientific specialty involved. Its engineers are in one of the best informed and highest prestige fields in their profession.

Whatever your present activity, if you decide to move into aircraft, missile and space technology, we would like to hear from you.

Please write to Mr. C. C. LaVene,
Douglas Aircraft Company, Box 600-M,
Santa Monica, California

Necklace Hunters

Attempts to string telegraph lines through the Masai tribal areas of Africa were almost foiled recently by necklace hunters. Wire was disappearing from poles as fast as it could be strung until linemen discovered natives were stealing the wire to make the coiled necklaces that cover the necks, arms and legs of their women.

Pistol-Packing Repairmen

Electric repairmen are packing pistols on the job. The gun fires a jet-propelled cartridge which tows a string through long electrical conduits. Electricians, who once needed an hour-and-a-half to get wire through some conduits, now can tie the wire to the string and get it through in two minutes.

Glass Spark Plugs

Spark plugs made of glass and insulated by gas are claimed by their Hungarian developer to be cheaper, more compact, easier to adjust than standard ceramic units. The Hungarian also states the glass plug produces a stronger spark.

Candy Cleans Oil Lines

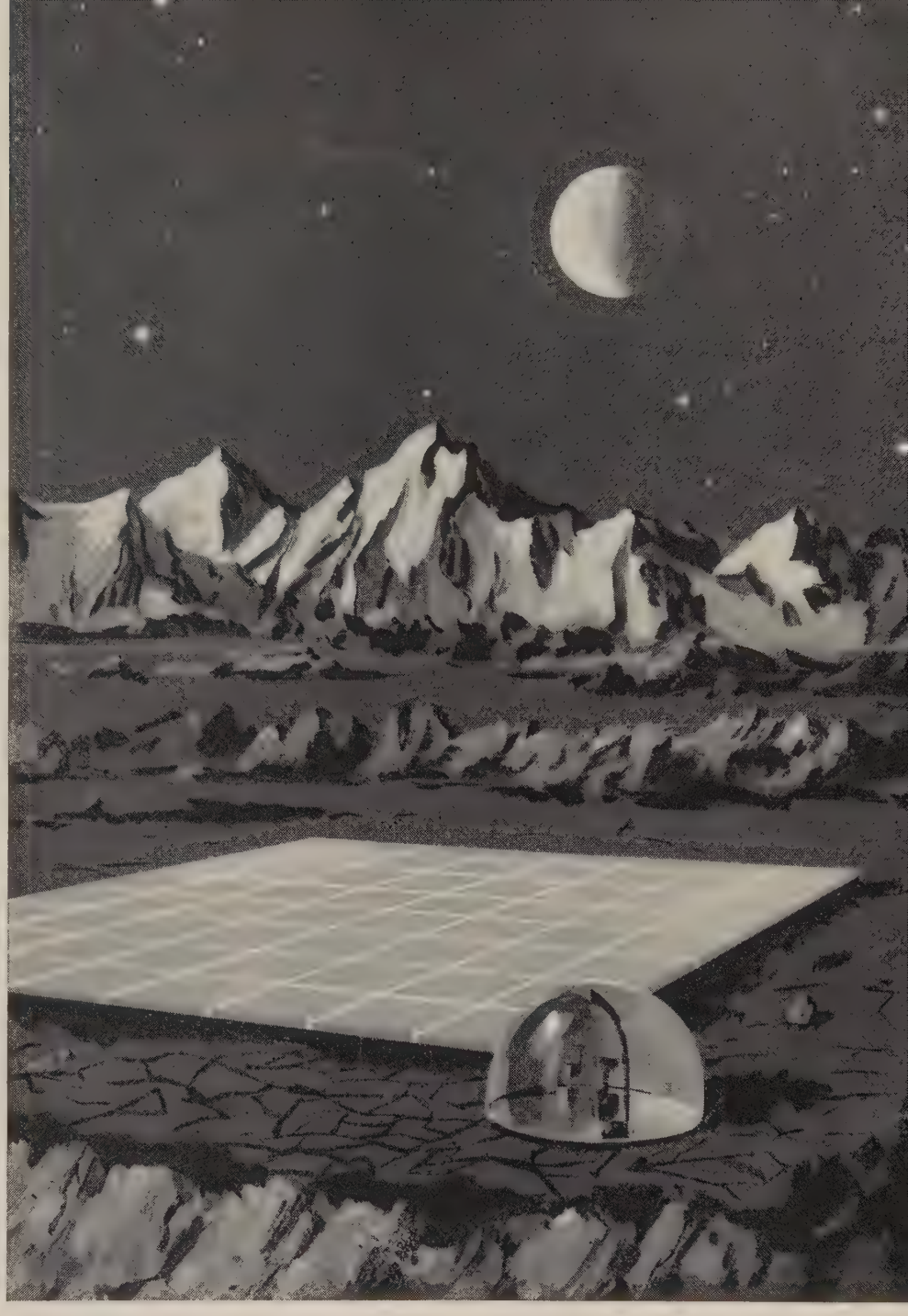
Jawbreaker candy balls are being used in the oil industry to dislodge paraffin in crude lines. Before the use of jawbreakers, a clogged pipe had to be pulled out and cleaned, shutting down the well. Now, the candy balls are rolled down the one-inch pipe. As they fall, they break up paraffin deposits. A screen catches them at the bottom, and they dissolve.

Automatic Train-Engineer

The Russians are testing a railway train operated by an automatic engineer. The human driver is replaced by an electronic computer and a programming device. The latter contains all information necessary for the normal run of the train along its route. Automatic drive, Russian railroad experts believe, should ensure greater safety and add up to an increase of railway-line capacity.

Who Uses It, and How Much?

Large industry accounted for less than one per cent of the total number of electric customers in 1957, yet they consumed 51 per cent of the electricity sold, reports Electrical Wholesaling. Residential users, comprising 85 per cent of total customers, consumer 26 per cent of the electricity sold. Commercial used 17 per cent of total electricity sold, with 11 per cent of total customers.



Westinghouse designs power plant for the moon to provide electricity for man's first space colony

Lunar explorations are no longer the mere dream of a few. Dedicated men all over the world are now actively at work on lunar projects. The first reconnaissance space craft have been launched.

Westinghouse, as part of its effort in the area of space technology, has already designed and demonstrated a practical power plant for use by man's first space colony on the moon. This Westinghouse plant will be very lightweight and compact to facilitate its transport, and it will produce a substantial quantity of electricity from the rays of the sun.

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS-TV MONDAYS

MARS outstanding design **SERIES**

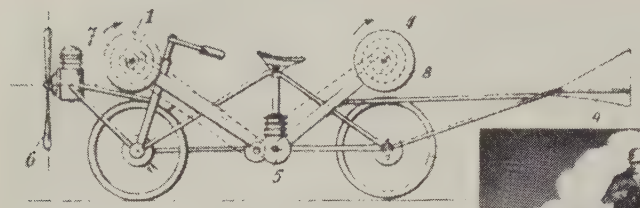


Fig. 1.

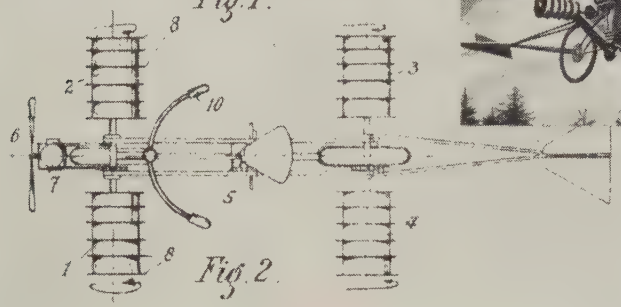


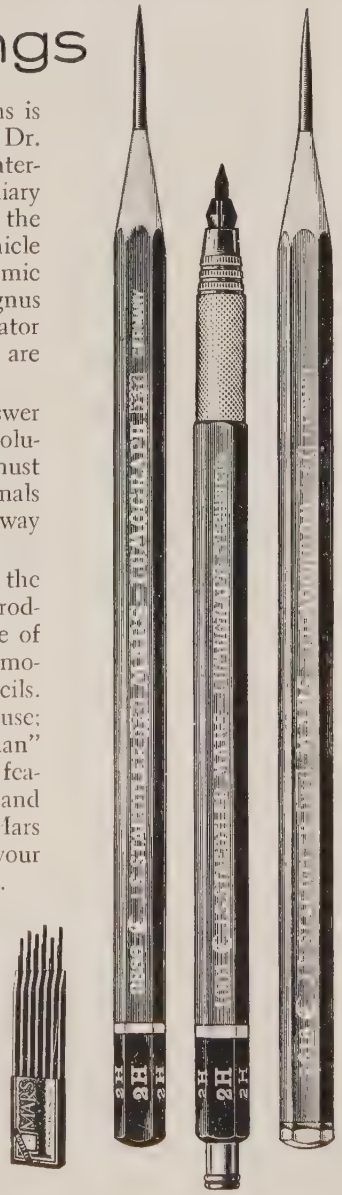
Fig. 2.

flight without wings

Getting over, rather than around, traffic jams is easy, with this flying motorcycle, says its designer Dr. Manfred Mannheimer, of Newark, N. J. Encountering heavy traffic, it quits the ground. An auxiliary motor rapidly rotates four cylindrical "wings." By the action of the "Magnus effect" these lift the vehicle into the air at 15 mph with 70 hp. The aerodynamic principle involved was discovered by Gustav Magnus in 1858. The cycle's tail-end has a rudder and elevator fin for steering during flight; the rotary wings are telescoped for surface travel.

Whether or not this design will be the answer to traffic congestion, it certainly is an ingenious solution. Aloft or aground, all engineering solutions must originate on the drafting board. And only professionals know how the best in drafting tools smooths the way from dream to practical project.

In pencils, of course, that means Mars, long the standard of professionals. Some outstanding new products have recently been added to the famous line of Mars-Technico push-button holders and leads, Lumograph pencils, and Tradition-Aquarell painting pencils. These include the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman" pencil sharpener with the adjustable point-length feature; Mars Lumochrom, the color-drafting pencils and leads that make color-coding possible; the new Mars Non-Print pencils and leads that "drop out" your notes and sketches when drawings are reproduced.



The 2886 Mars-Lumograph drawing pencil, 19 degrees, EXEXB to 9H. The 1001 Mars-Technico push-button lead holder. 1904 Mars-Lumograph imported leads, 18 degrees, EXB to 9H. Mars-Lumochrom color-drafting pencil, 24 colors.

J.S. STAEDTLER, INC.
HACKENSACK, NEW JERSEY

at all good engineering and drawing material suppliers

Listen To Who's 'Talking'

Production machines that "talk back" to man—in his own language—are making themselves heard in the expanding age of automation. Any number of statements, reflecting almost any situation the machine might encounter, can be set into the "memory." Choice of the proper statement would depend on the situation the machine meets. The computer selects and prints out the phrase. The machine's back talk ranges from strictly business-like phrases such as "Have revised your last instruction" to "Let's not botch it up again, Bud."

Fluoridation Advances

Despite opposition, fluoridation is becoming part of the municipal water-treating process of more and more communities. By the end of the year, some 1,650 towns and cities, with a combined population of more than 34 million people will be provided with fluoride-treated drinking water. Just eight years ago, only 94 communities, with a total population of 1.5 million people had it.

"Enriched" Milk

An Alaskan dairy prints oil-lease certificates on the sides of milk cartons, reports Food Engineering. Twenty-five entitle the bearer to a ten-thousandth interest in a genuine oil-producing area.

Car Counter

Radar is being used to make traffic counts for the Florida State Road Department. The unit is suspended over the highway, rather than on it. Since it counts vehicles instead of axles, as the standard tube counter does, it has given a more accurate hourly vehicle count. It also can be used to tally traffic in individual lanes.

Heatable Bread Package

A novel bread package is gaining in popularity. A bakery is using a foil-paper laminated bag to package its extra-long loaves. The bags can be used to heat the bread on an outdoor grill or in the oven. A simple fold closes the bag and re-use is an appeal to the housewife.

Wall Switch Has New Look

A wall switch that is completely new in styling has been introduced on the market, reports Electrical World. The new switch is a straight-sided, rectangular wall plate. It is touched at the top for "on" and at the bottom for "off."

TECHNOCRACKS

A toast to that prehistoric genius who took two logs and made the first log-log slide rule.

* * *

They laughed at Watt, too, until he invented the Watt Schmacallit.

* * *

Eng I: "If angular momentum can't be created, where did it come from in the first place?"
Prof: "Why, the torque brought it."

* * *

"I see there's a big shortage of sanitary engineers."
"You don't have to tell me, I lived in a frat house."

* * *

Sanitary Engineer: Fellow who looks after Number Two!

* * *

Prof: "What's the formula for ethanol, young man?"
Chem I: "Er, HOOCH."

* * *

Judge: "What's your occupation, mister?"
Ye Ed: "Why, I'm humor editor for the Technograph."
Judge: "Ten days for punhandling."

* * *

What this country needs is a good 5 cent cigar joke.

* * *

"Doctor, my ears keep ringing."
"Nobody home, huh?"

* * *

"Mr. Watson, come here, I want you!"
"Sorry, Mr. Bell, I'm in the tub."

* * *

"All right, what HATH God wrought?"

* * *

He has a pretty level head, if by level you mean flat.

* * *

"I've just been reading Aristophane's play, "Rain." That's a condensation of "The Clouds."

* * *

"I have classes down at the Pier. Why don't you drop over some time?"

* * *

She was only a spaceman's daughter, but she knew a Thing or two.

* * *

"Do you keep stationary?" he inquired of the girl behind the counter.
"Oh, up to a point," she giggled. "Then I just go all to pieces."

Westinghouse is the best place for talented engineers

The preceding four advertisements have only touched upon Westinghouse activities related to space. Some of the other projects in this area include the investigation of electronic and mechanical phenomena in high vacuums, work with special metals, and the development of various devices for satellite reconnaissance purposes. There are also a number of highly-classified projects.

The wide variety of engineering and scientific work at Westinghouse demands the services of really talented engineers. This *diversity of opportunity* is one of the biggest reasons why so many outstanding engineers have chosen Westinghouse over the years, and the variety of work being done today is greater than it has ever been before. Guided missile controls, atomic power, automation, radar, semi-conductors, and large power equipment are only a few of the other fascinating career fields to be found at Westinghouse.

Why not find out now about the opportunities for you at Westinghouse? Write to Mr. L. H. Noggle, Westinghouse Educational Department, Ardmore and Brinton Roads, Pittsburgh 21, Pa.

YOU CAN BE SURE...IF IT'S **Westinghouse**

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS-TV MONDAYS

Begged, Borrowed, and . . .

Edited by The Staff

"Frequent water drinking," said the specialist, "prevents you from becoming stiff at the joints."

"Yes," said the patient, "but some of the joints don't serve water!"

* * *

The scene is a train compartment in Romania. The characters: A Russian officer, a Romanian, an old lady, and an attractive girl.

The train enters a tunnel. The passengers hear first a kiss, then a vigorous slap.

The old lady thinks: "What a good girl she is, such good manners, such fine moral character!"

The girl thinks: "Isn't it odd that the Russian tried to kiss the old lady and not me?"

The Russian thinks: "That Romanian is a smart fellow: he steals a kiss and I get slapped."

The Romanian thinks: "Am I a smart fellow! I kiss the back of my hand, hit a Russian officer, and get away with it."

* * *

The legend is told that in the days of ancient Rome an officer, called away to the wars, locked his beautiful young wife in armor and gave the key to his best friend, with the admonition: "If I don't return in six months, use this key. To you, my dear friend, I entrust it."

Ten miles away from home, he saw a cloud of dust approaching and waited.

His friend, on horseback, galloped up saying: "You gave me the wrong key."

* * *

Two bopsters in a museum spotted a bust of Julius Caesar. One said to the other, "This guy has been gone for 2000 years."

The other replied, "Crazy man, those Romans really knew how to live."

* * *

A careless young Communist, Tom,
Started fooling about with a bomb.
They got most of him up
With a teaspoon and cup.
And the rest with a hairbrush and comb.

* * *

A bar stool is what Dan'l Boone nearly stepped in.

The ice man smiled as his glance fell on this sign: "Please drive slowly. The child in the street may be yours."

* * *

I.E.: "I hear the Board of Trustees is trying to stop necking."

* * *

E.E.: "That so? First thing you know it'll be trying to make the students stop, too."

* * *

Young wife dejectedly—My husband never used to snore before we were married.

* * *

It happened a few years ago at a fashionable wedding. One of our grande dames swept into the church, dressed as usual in an old-fashioned manner.

Among her accessories was a huge ostrich fan which she opened and used —the church being warm.

A small boy seated with his parents convulsed the occupants of nearby pews with his inquiry, "Who's that, mother —Sally Rand?"

* * *

A man in the insane asylum sat fishing over a flower bed. A visiting sociology student, wishing to be affable, asked,

"How many have you caught?"

And the fisherman returned, "You're the ninth."

* * *

She: "I don't believe you know what good clean fun is."

E.E.: "All right, what good is it?"

* * *

Lady, if you'll give us a nickel, my brother will imitate a hen."

"What will he do, cackle?"

"Naw, he wouldn't do a cheap imitation like that. He'll eat a worm."

* * *

Chaplain (to prisoner in electric chair): Can I do anything for you?

Prisoner: Yes, hold my haid.

* * *

What would you do if you had five dates with a man and he didn't attempt to kiss you?"

"I'd lie about it."

He was a really tough hombre, wanted in two states: Dead or Alive.

* * *

Whiskey kills more than rattlesnakes.

Rattlesnakes don't drink while driving.

* * *

Of course, the principal ingredient in a cup of coffee will kill you, if inhaled.

* * *

Everyone admires a good loser, particulraly if he loses to him.

* * *

The baby carriage: a blunder buss

* * *

I once knew a fellow named gusser
Whose knowledge got lesser and lesser.
It at last grew so small,
He knew nothing at all—
And now he's a college professor.

* * *

Salesman: "I have here the one and only sure cure for dandruff."

Housewife: "Really, how does it work?"

Salesman: "Oh, it's awfully simple —it's a mixture of alcohol and sand."

Housewife: "But how does it cure dandruff?"

Salesman: "Well, you just rub the mixture on your hair; then the bugs get drunk and kill each other throwing rocks."

* * *

Mary had a little skirt,
She stood against the light;
Who gives a damn,
For Mary's lamb,
With Mary's calves in sight?

* * *

He: "Whisper those three little words that will make me walk on air."

She: "Go hang yourself."

* * *

"Drop in some night," said the Eskimo, "and we'll chew the fat."

* * *

A gentleman called a spade a spade until he tripped over one in the dark.

* * *

A friend is a guy with the same enemies as you have.

PHOTOGRAPHY AT WORK—No. 16 in a series

Kodak
TRADE-MARK

In the Arma Visual Computer, a single control selects the desired chart from as many as 700 photo slides. Each slide contains punched code holes which automatically tune in the corresponding Omni Bearing Distance station. The image of the plane is governed by a combination of the radio signals and the plane's gyro instruments.

Photography teams with electronics and adds new certainty to flight

Now a visual computer pictures a plane's precise position and heading on projected photos of aeronautical maps.

Arma Division, American Bosch Arma Corp., working with the Air Navigation Development Board and C.A.A., has developed a valuable new aid in air navigation using photography.

With it the pilot, high above the weather, flicks a switch and before him appears a map of the area he's over. On the screen a tiny shadow of a plane moves and shows exactly where he is, where he's heading and whether he's on course.

This spells added certainty. Even more! It can mean savings in time and money, too. For the flight can proceed by plan rather than by dog-legs on the beams.

So again we see photography at work helping to improve operations—doing it for commercial aviation just as it does for manufacturing and distribution.

Photography works in many ways for all kinds of business, large and small. It is saving time, saving money, bettering methods.

CAREERS WITH KODAK

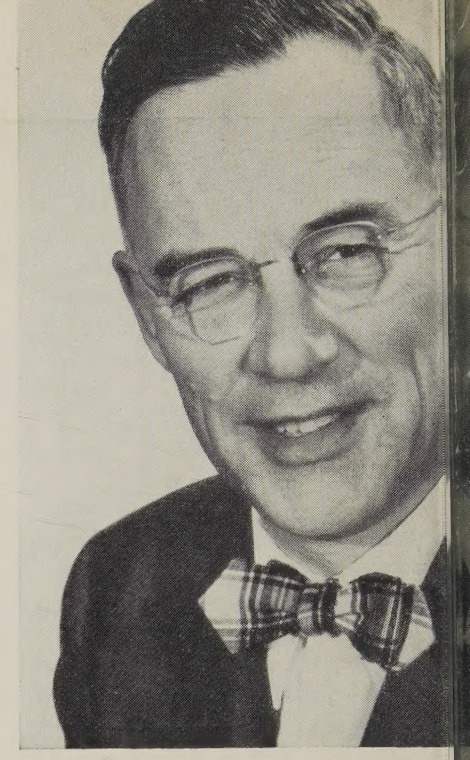
With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company, Rochester 4, N. Y.

One of a series

General Electric interviews Dr. Richard Folsom, President of Rensselaer Polytechnic Institute, to explore . . .



Teaching— A Career Opportunity For the Engineer

Leading educators, statesmen and industrialists throughout the country are greatly concerned with the current shortage of high-caliber graduates who are seriously considering a career in the field of science or engineering education. Consequently, General Electric has taken this opportunity to explore, with one of America's eminent educators, the opportunities and rewards teaching offers the scientific or engineering student.

Q. Is there in fact a current and continuing need for educators in technical colleges and universities?

A. Colleges and universities providing scientific and engineering educational opportunities are hard pressed at the present moment to obtain the services of a sufficient number of well-qualified teachers to adequately carry out their programs. Projected statistical studies show that this critical need could extend over the next 15 or 20 years.

Q. Why is this need not being met?

A. There are probably three main reasons. These might be classed under conditions of financial return, prestige associated with the position, and lack of knowledge and understanding on the part of the college student of the advantages and rewards teaching as a career can afford.

Q. What steps have been taken to make education a more attractive field to engineering students?

A. Steps are being taken in all areas. For example, we have seen a great deal in the newspapers relating educators' salaries to the importance of the job they are doing. Indications are that these efforts are beginning to bear fruit. Greater professional stature is being achieved as the general public understands that the youth of our nation is the most valuable natural resource that we possess . . . and that those associated with the education of this youth have one of the most important assignments in our country today.

Q. Aside from salary, what rewards can a career in education offer as opposed to careers in government or industry?

A. The principal rewards might be freedom to pursue your own ideas within the general framework of the school, in teaching, research and consulting activities. As colleges and universities are normally organized, a man has three months in the summer time to engage in activities of his own choice. In addition, the educator is in direct contact with students and he has the satisfaction of seeing these students develop under his direction . . . to see them take important positions in local and national affairs.

Q. What preparation should an engineering student undertake for a teaching career?

A. In college, the engineering student should obtain a basic understanding of science, engineering science, humanities and social sciences with some applications in one or more professional engineering areas. He should have frequent career discussions with faculty members and his dean. During graduate work, a desirable activity, the student should have an opportunity to do some teaching.

Q. Must an engineering student obtain advanced degrees before he can teach?

A. It is not absolutely necessary. On the other hand, without advanced degrees, advancement in the academic world would be extremely difficult.

Q. How valuable do you feel industrial experience is to an engineering or scientific educator?

A. Industrial experience for a science educator is desirable; however, with senior engineering educator, industria experience is a "must". An ideal en gineering educator should have ha enough industrial experience so that h understands the problems and responsi bilities in carrying a project from it formative stages to successful comple tion, including not only the technica aspects, but the economic and persona relationships also.

Q. What do you consider to be the op timum method by which an educator car obtain industrial experience?

A. There are many methods. After completion of graduate school, perhaps the most beneficial is a limited but intensive work period in industry. Consulting during an academic year o summer is a helpful activity and is desirable for older members of the staff. Younger educators usually need experience in "living with the job" rather than providing consultant's advice to the responsible individual.

Q. Based on your experience, what personal characteristics are possessed by successful professors?

A. Primarily, successful professors have an excellent and growing knowledge of their subjects, are interested in people, and transmit enthusiasm. They have an ability to explain and impart information with ease. They generate ideas and carry them out because they are devoted to developing their fields of knowledge. They desire personal freedom and action.

For further information on challenging career opportunities in the field of science and engineering education, write to: Mr. W. Leighton Collins, Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill.

959-10

GENERAL ELECTRIC